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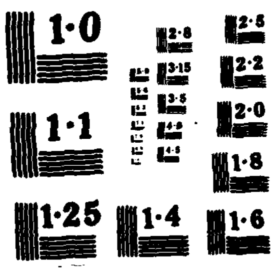
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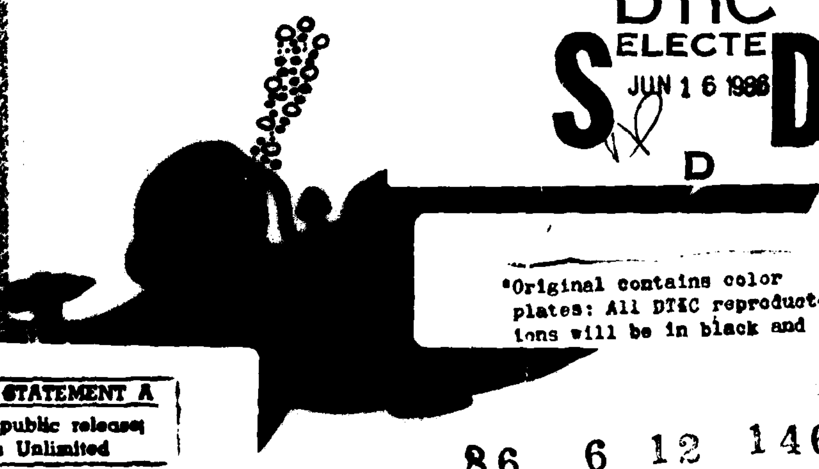
UNDERWATER FACILITIES INSPECTIONS & ASSESSMENTS

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C. 20374



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UNDERWATER FACILITIES

INSPECTION AND ASSESSMENT

AT

NAVAL WEAPONS STATION CONCORD, CALIFORNIA

FPO-1-83-(19) May, 1983

Performed for:

Ocean Engineering and Construction Project Office
Chesapeake Division
Naval Facilities Engineering Command
Washington, D.C. 20374

Under:

Contract N62477-81-C-0498
Task 2

By:

J. Agi & Associates Co. Inc.
141- Alaskan Way, Suite 600
Seattle, Washington, 98101

Project No: 83-1/3-2-100

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Underwater inspection, Naval Weapons Station Concord, CA, Concord, CA

19. ABSTRACT (Continue on reverse if necessary & identify by block number)
Two marine structures at Naval Weapons Station, Concord, California, were subjected to nondestructive testing and inspection. A sampling of concrete and timber piles were examined in Piers 3 and 4. The structures were subjected to a Level I, II and and in some cases, Level III inspection using (Con't)

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visual/tactile and ultrasonic techniques. Significant elements were photo-documented.

The objective of the underwater facility assessment conducted at NWS Concord, is to provide a generalized structural condition and repair requirements report on the designated facilities within the activity.

In Pier 3, a Level I inspection was carried out on 200 concrete and 974 timber piles; a Level II inspection was carried out on 50 concrete piles; and Level III ultrasonic testing was carried out on 393 timber piles. The overall condition of the examined piles is very good. Two concrete piles were noted to have sustained significant damage as a result of mechanical impact and/or abrasion, marine borer infestation and/or fungal decay. In addition, a total of 30 timber piles were noted to have sustained minor attack or damage which is not of structural significance at this time. Repair of the 10 defective timber piles should be considered and periodic inspections are recommended.

In Pier 4, a Level I inspection was carried out on 222 concrete and 952 timber piles; a Level II inspection was carried out on 50 concrete piles; and Level III ultrasonic testing was carried out on 393 timber piles. The overall condition of the examined piles is very good. All concrete piles were found to be in excellent condition, no evidence of damage was found. A total 13 timber piles have sustained significant damage as a result of mechanical impact or abrasion, marine borer infestation and/or fungal decay. In addition, a total of 50 timber piles have sustained minor attack or damage which is not of structural significance at this time. Repair of the 13 defective piles should be considered and periodic inspections are recommended.

EXECUTIVE SUMMARY

Two marine structures at Naval Weapons Station, Concord, California, were subjected to nondestructive testing and inspection. A sampling of concrete and timber piles were examined in Piers 3 and 4. The structures were subjected to a Level I, II and in some cases, Level III inspection using visual/tactile and ultrasonic techniques. Significant elements were photo-documented.

The objective of the underwater facility assessment conducted at NWS Concord, is to provide a generalized structural condition and repair requirements report on the designated facilities within the activity.

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Refer to the accompanying Executive Summary Table for details.

EXECUTIVE SUMMARY TABLE

FACILITY	YEAR BUILT	STRUCTURE SIZE	STRUCTURE TYPE	RECOMMENDATIONS	ESTIMATED COST OF RECOMMENDATIONS
PIER 3	1944	1248' X 89'	3783 timber piles 494 concrete piles	Repair 10 timber piles	$20,000
PIER 4	1945	1248' X 89'	3783 timber piles 494 concrete piles	Repair 13 timber piles	$26,000

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(Concluded)

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SECTION 1 - INTRODUCTION

1.1 CONTRACT

Department of the Navy,
Chesapeake Division,
Naval Facilities Engineering Command,
Building 212, Washington Navy Yard,
Washington, D.C. 20374

1.2 CONTRACT NO.

N62477-81-C-0498
Task 2

1.3 CONTRACT DATE

September 30, 1982

1.4 CONTRACT DESCRIPTION

The contractor shall provide all required engineering services necessary for underwater assessment of various Navy waterfront facilities as directed by the officer in charge and as specifically described in individual orders. The second award under this contract is for the assessment of the structural condition of underwater structural members at waterfront facilities, Naval Weapons Station, Concord, California. The following table details the specific scope of work for this project.

FACILITY	TYPE OF INSPECTION		
	LEVEL I	LEVEL II	LEVEL III
	No. of Piles Concrete and Timber	No. of Piles Concrete	No. of Piles Timber
Pier 3	1174	50	393
Pier 4	1174	50	393
Totals:	2348	100	786

1.5 INTRODUCTION TO PROJECT

This report is prepared under the Underwater Inspection Program conducted by the Ocean Engineering Project Office (FPO-1), Chesapeake Division, Naval Facilities Engineering Command as part of NAVFAC's specialized Inspection Program. This is a task oriented engineering service program in support of inspection, analysis and design of repairs of the submerged portions of Navy Waterfront facilities.

This report covers the inspection carried out on the various facilities at the U.S. Naval Weapons Station, Concord, California. The purpose of the underwater assessment is to provide a generalized structural condition and repair requirements report on the designated facilities within the activity.

A description of each facility, its location and mission is provided. Detailed results with respect to individual piling, overall assessment of structural condition and recommendations are also given.

1.6 DEFINITIONS: LEVEL I, II, III INSPECTIONS

Level I: General Inspection: This type of inspection is essentially a "swim-by" overview, which does not involve cleaning of any structural elements, and can therefore be conducted much more rapidly than the other levels of inspection. The Level I inspection should confirm as-built structural plans and detect obvious major damage or deterioration due to overstress (collisions, ice), severe corrosion, or extensive biological growth and attack. The underwater inspector shall generally rely primarily on visual and/or tactile observations (depending on water clarity) to make condition assessments. These observations are normally made over the specified exterior surface area of the underwater structure whether it is a quaywall, bulkhead, seawall, pile, or mooring. Visual documentation (utilizing underwater television and/or photography), may be included with the quantity and quality adequate for documentation of the findings which will be representative of the facility condition.

Level II: Detailed Inspection: This type of inspection is directed toward detecting and describing damage/deteriorated areas which may be hidden by surface biofouling or deterioration and toward obtaining a limited amount of deterioration measurements. These data should be sufficient to enable gross estimates to be made of facility load capability. Level II inspections will often require cleaning of structural elements. Since cleaning time is consuming, it is generally restricted to areas that are critical or which may be representative of the entire structure itself. The amount and thoroughness of cleaning to be performed is governed by what is necessary to discern the general condition of the overall facility.

Simple instruments such as calipers, measuring scales and ice picks are commonly used to take physical measurements.

However, a small percentage of more accurate measurements may also be taken with more sophisticated instruments for several reasons. These measurements will validate large numbers of simple measurements and in some hard to measure areas, will actually be easier and faster to obtain. Where the visual scrutiny, cleaning, and/or simple measurements reveal extensive deterioration, a small sampling of detailed measurements will enable gross estimates to be made of the structure's integrity. For example, on extensively corroded steel H piles, a small percentage should receive ultrasonic thickness measurements to determine typical cross-section profiles. The cross-sections determined by these spot checks would be used to determine individual H pile load capability which would then be extrapolated to obtain a "ballpark" estimate of overall facility load capability. Visual documentation (utilizing underwater television and/or photography) should be included with the quantity and quality adequate to be representative of the range of facility damage/deterioration.

Level III: Highly Detailed Inspection: This type of inspection will often require the use of Non-Destructive Testing (NDT) Techniques, but may also require the use of partially destructive techniques such as sample coring through concrete and wood structures, physical material sampling, or in-situ surface hardness testing. The purpose of this type of inspection is to detect hidden or interior damage, loss in cross-sectional area and material homogeneity. A Level III inspection will usually require prior cleaning. The use of NDT techniques are generally limited to key structural areas, areas that may be suspect, or to structural members which may be representative of the underwater structure. Visual documentation (utilizing underwater television and/or photography) and a sampling of physical measurements should be included with quantity and quality adequate for documentation of the findings which will be representative of the facility condition.

SECTION 2 - ACTIVITY DESCRIPTION

This section provides a general description of the Naval Weapons Station, Concord, (NWSC) which is the primary port of embarkation for ordnance materials on the West Coast. The description includes a brief discussion of the Weapons Station location, mission, climate and other environmental factors. This information which has been extracted from the government furnished information (GFI) Master plan, provides a more overall view of the activity.

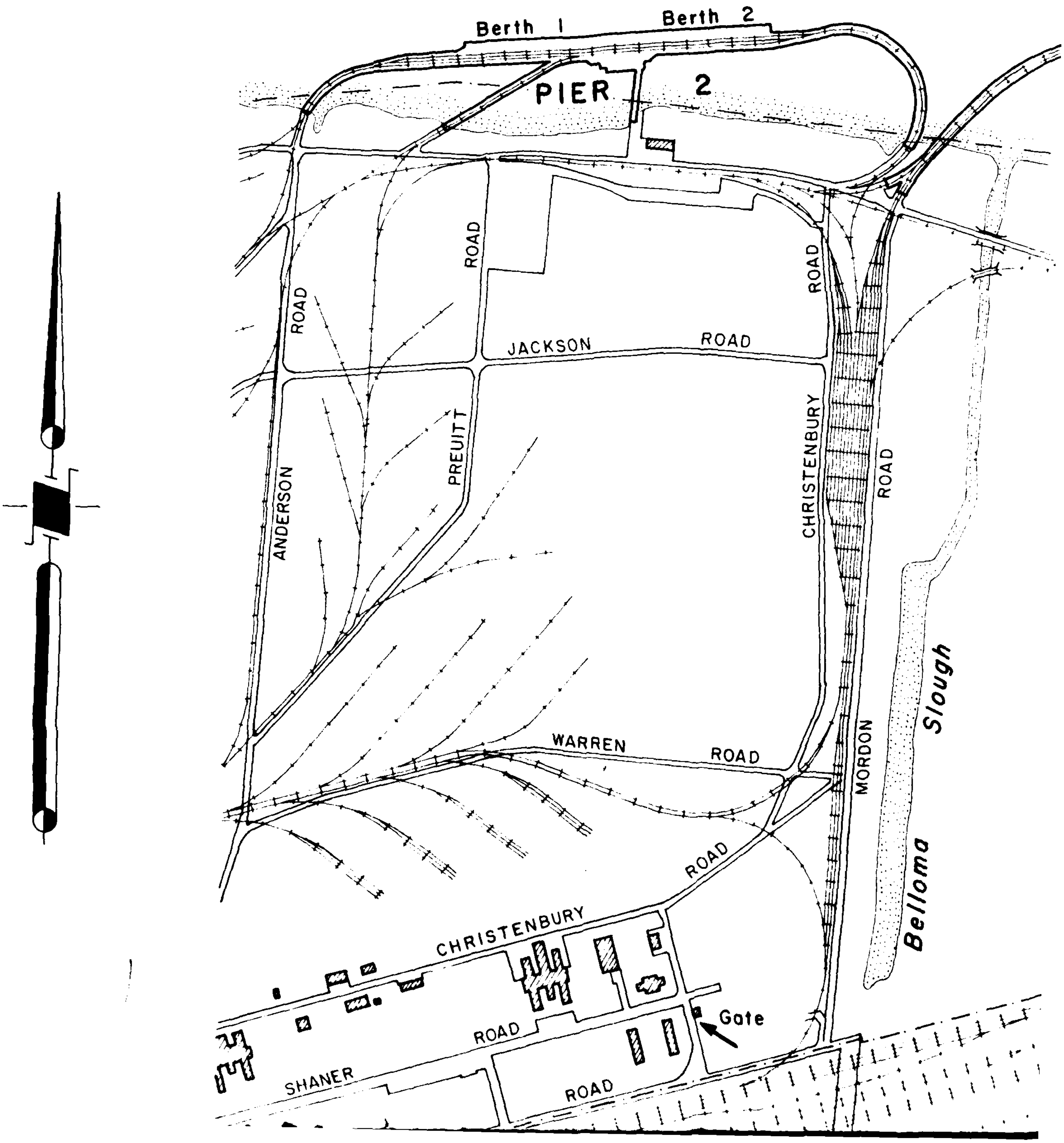
2.1 LOCATION OF ACTIVITY

The San Francisco Bay area (Drawing No.1), which encompasses 6100 square miles, has extensive shoreline along both the Bay and the Pacific Ocean. The area is composed of coastal mountain ranges, fertile valleys, numerous estuaries and marshes, and rolling hills. San Francisco Bay consists of four separate bays: Suisun, San Pablo, Lower San Francisco, and San Francisco Proper.

Lying southeast of San Pablo Bay and south of Suisun Bay is Contra Costa County. The Naval Weapons Station, Concord is in the north central portion of the 800-square-mile county. The station is about ten miles west of the confluence of the Sacramento and San Joaquin Rivers. This confluence forms the environmentally significant Delta region which contains about 600 miles of interconnected and meandering tidal waterways.

2.2 EXISTING WATERFRONT FACILITIES AT ACTIVITY

The major waterfront facilities at NWSC include Piers 2, 3 and 4. In addition, a barge pier and a series of lighter mooring dolphins are located to the west or downstream of Pier 2 (see Drawing No.1). The facilities are utilized to operate and maintain an ocean terminal facility to tranship ordnance material.



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PIER 2
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ROAD
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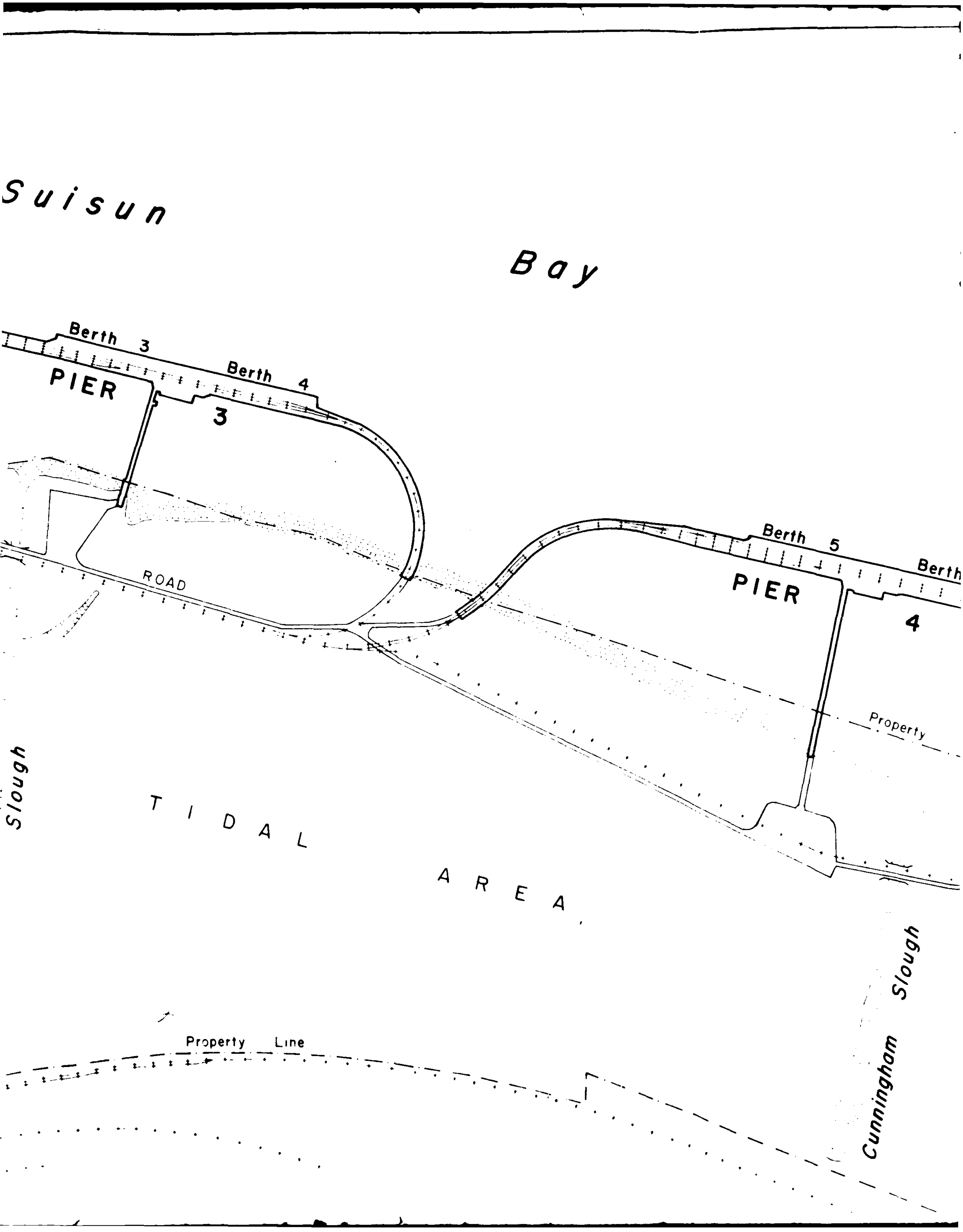
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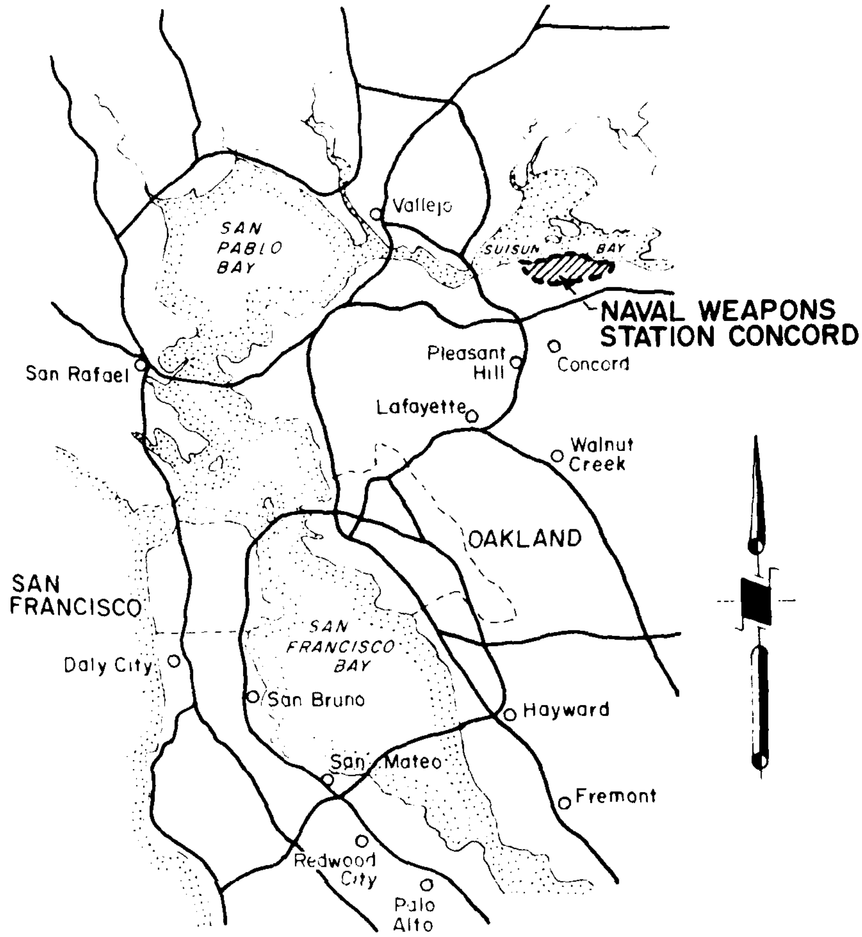
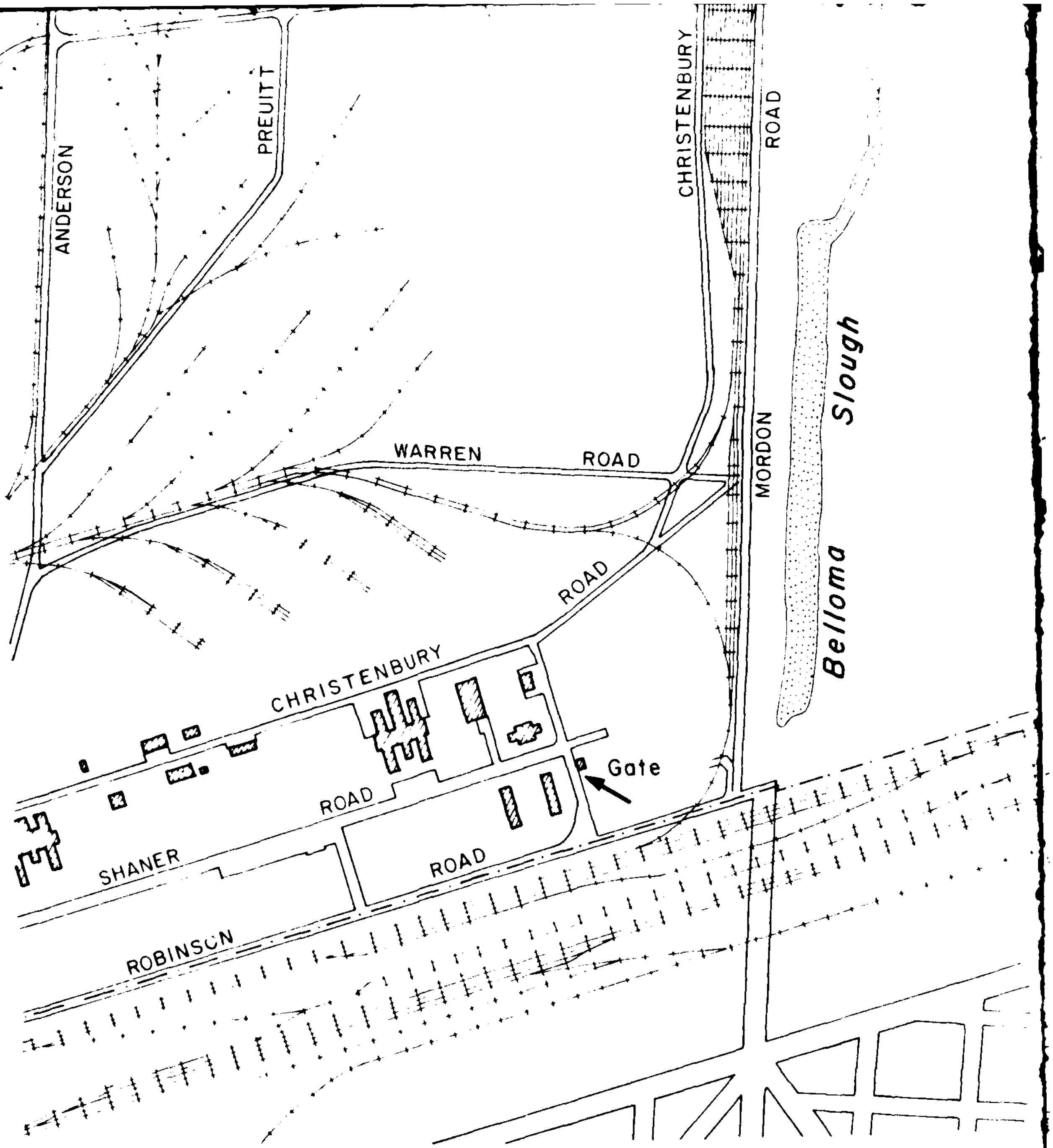


REGIONAL MAP

1" = 10 miles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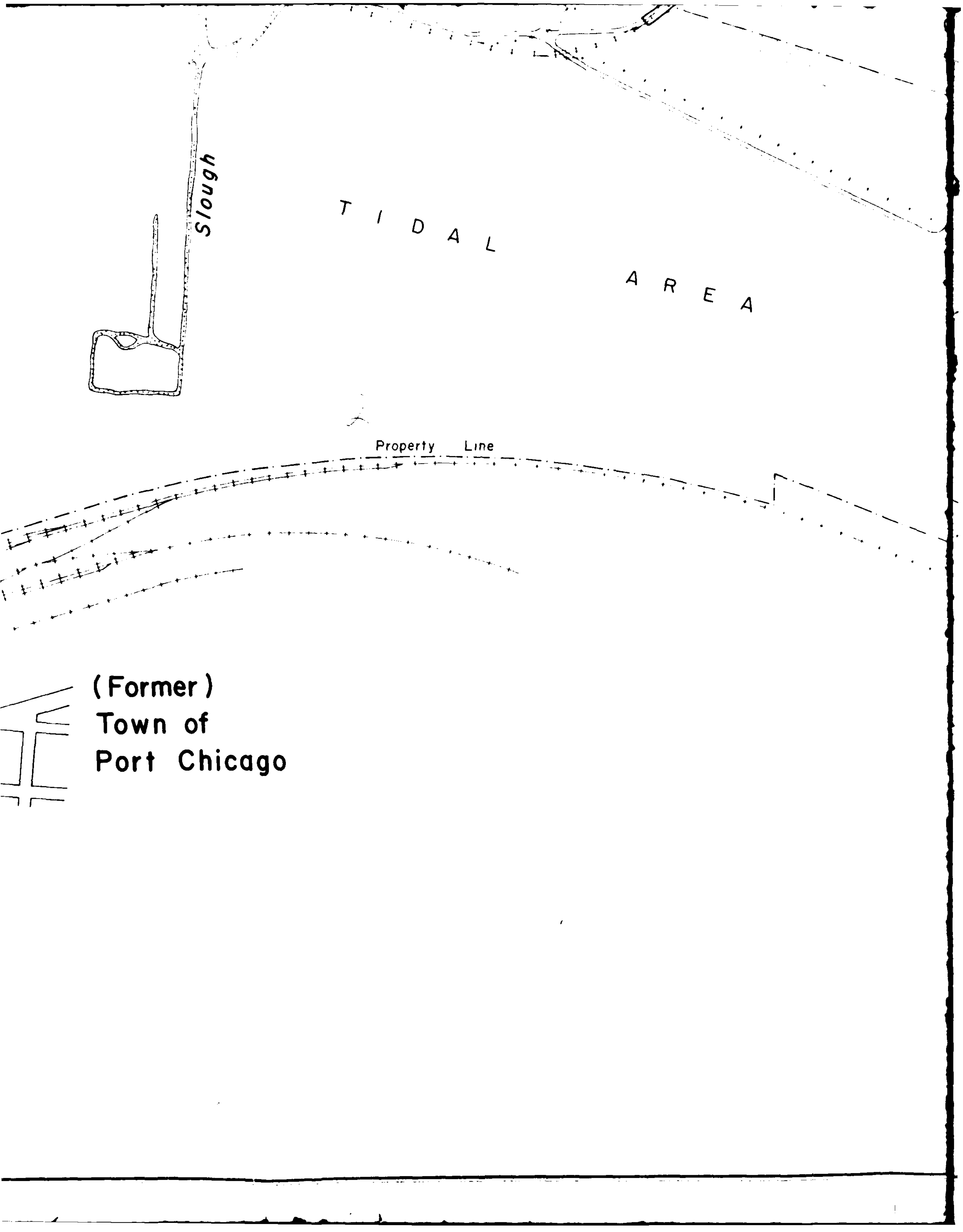
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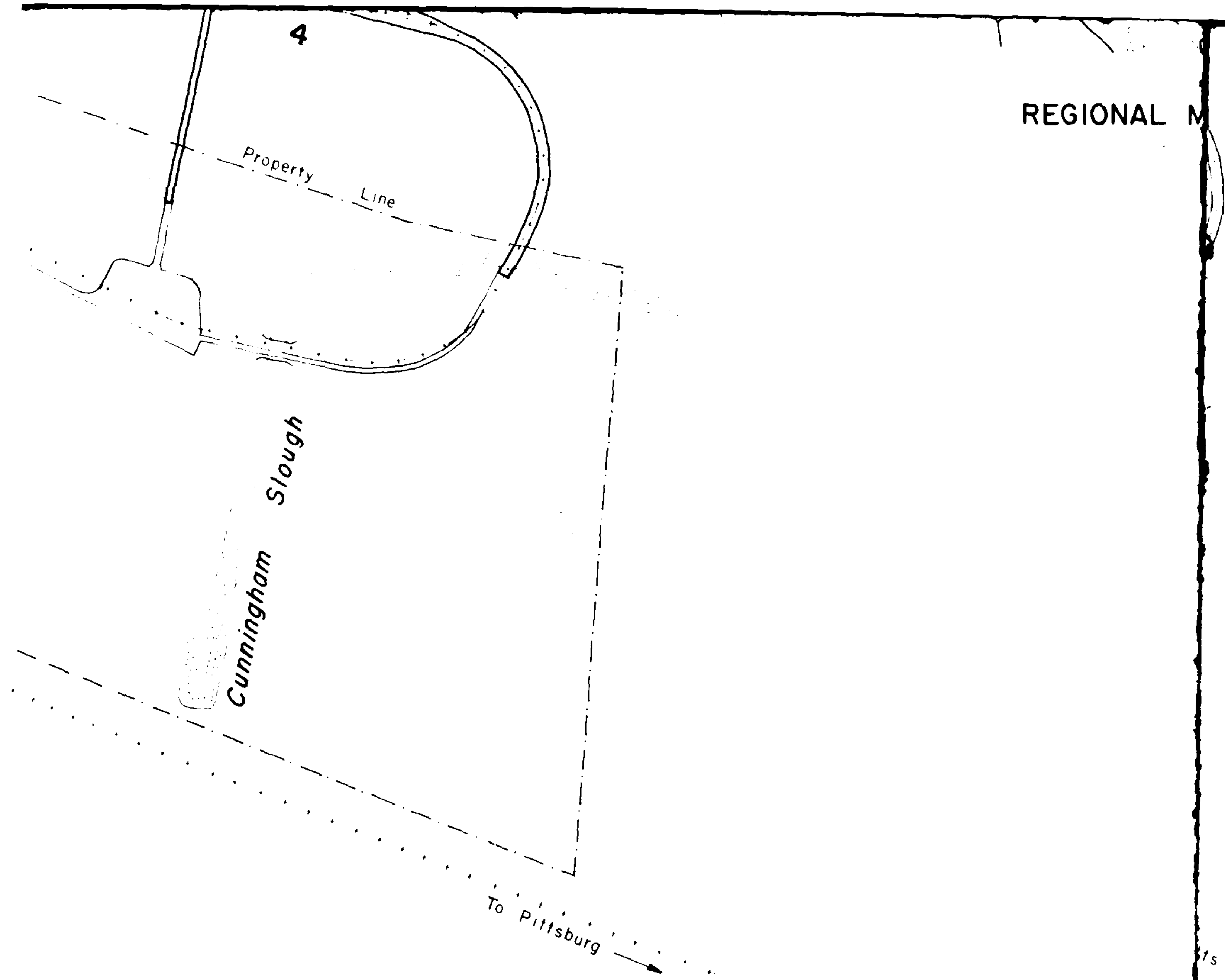
TIDAL AREA
Property Line
(Former)
Town of
Port Chicago



Reference Dwg, Y and D Dwg No [illegible]

J. AGI & ASSOCIATES C
Suite 600, 1414 Alaskan Way, Seatt

PLAN SHOWING VICINITY MAP A
LOCATION OF INSPECTED STRUCT
U.S. NAVAL WEAPONS STATIO
CONCORD, CALIFORNIA

CHES DIV NAV FAC ENG COM
REPORT No FPO - 1 - 83 - (1
CONTRACT No N62477 - 81 - C -
TASK 2

DWG. No. 1

REGIONAL MAP

Reference Dwg, Y and D Dwg No. 1115131

J. AGI & ASSOCIATES CO. LTD. Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE 1" = 400'
	DRAWN F P
PLAN SHOWING VICINITY MAP AND LOCATION OF INSPECTED STRUCTURES U.S. NAVAL WEAPONS STATION CONCORD, CALIFORNIA	CHECKED J.I.
	APPROVED XIE
CHES DIV NAV FAC ENG COM REPORT No FPO - 1 - 83 - (19) CONTRACT No N 62477 - 81 - C - 0498 TASK 2	DATE MAY 25, 1983
DWG. No. 1	PROJECT No 83-1/3-2-100

2.3 MISSION OF ACTIVITY

Naval Weapons Station, Concord performs a dual role within the Naval Sea Systems Command. The station functions as the primary port of embarkation for ordnance materials on the west coast. It is the homeport for the ammunition ships (AE's). The station is also one of the five weapons stations maintained by NAVSEA to provide fleet combatants with ready-for-use ordnance.

2.4 ENVIRONMENTAL DATA

Climate: The wind blows from the northwest most of the year causing the Pacific Ocean and the Suisun Bay to influence the climate. As a result of the influx of moderate oceanic air, Contra Costa County has a dry, warm summer and moderately rainy winter climate. The countywide mean annual temperature is 59 degrees Farenheit with moderate variation throughout the county. The average January temperature is about 46 degrees and the average July temperature is about 76 degrees F. The average frost-free season is about 265 days.

Rainfall occurs almost exclusively in the period from October to May, with an average annual amount ranging from 13 inches in the eastern portion to over 30 inches on the upper slopes of Mt. Diablo. Snow falls on Mt. Diablo occasionally, but the accumulation is small and lasts only a few days.

Physiography: Contra Costa County consists of four general physiographic regions: the highlands of the Coast Range, the intermountain valleys, the San Francisco Bay depression, and the Sacramento-San Joaquin Delta. The Diablo Range has smooth rolling hills and relatively rugged mountains ranging from 100 feet along the San Francisco Bay depression and San Joaquin Valley to 3849 feet at Mt. Diablo, which is a prominent landmark.

The San Francisco Bay depression and intermountain valleys consist of nearly level flood plains and low terraces with gently rolling fans and old terrace remnants adjacent to the uplands. Most of the low lying river delta lands have been reclaimed by protective dykes and drainage ways forming islands ranging from 30 to 7000 acres.

Except for a few small streamways draining west into San Francisco Bay, the drainage of Contra Costa County enters the San Joaquin River, San Pablo Bay or Suisun Bay to the north and east.

Originally, the tidal area consisted of three distinct land formations: salt marshes along the shore of the Suisun Bay, upland colluvial slope, and the sandstone hills furthest from the water. A large section of the marshland was modified, when the original weapons station was constructed, by adding large amounts of fill material. Almost all existing tidal facilities were built in these areas. The land designated colluvial slope is the most suitable for development because of higher elevation and gentle slope. The former city of Port Chicago was located in this area. The area to the south of Contra Costa Canal is characterized by steeply sloping terrain, beginning with a 100-foot elevation and rising to over 600 feet. The hills are composed of soft sandstone which is poorly suited for construction.

Geology: The geology of Contra Costa County is dominated by several northwest trending fault systems which divide the county into large blocks of rock. Within a particular block, the rock sequence consists of: (1) a basement complex of broken and jumbled sedimentary, igneous, and metamorphic rocks; (2) a section of younger sedimentary rocks more than 35,000 feet thick; (3) volcanic rocks which locally interconnect with and overlie the sedimentary section, and (4) surficial deposits including slides, alluvial fans, and bay plain deposits.

The California landscape is still being formed by geologic forces and is one of the most seismically active areas of the world. Lines of stress created by this formation process accumulate energy which is relieved only through movement of large structured blocks. The stresslines or faults, in Contra Costa County that have shown signs of movement include the Hayward and Calaveras faults. The Hayward fault is creeping in several locations and was the source of severe earthquakes in 1836 and 1868. Since 1934 nearly 200 earthquakes have been recorded in central Contra Costa County. Ten of these had magnitudes ranging from 4.0 to 5.4 on the Richter scale. Faults in the county that are considered to be active by the U.S. Geological Survey include the Antioch, Concord and Pleasanton faults. Additionally, faults of undetermined status include the Pinole, Franklin, Clayton-Marsh Creek and Mt. Diablo.

Parts of the Clayton-Marsh Creek geologic fault line and its lateral projections extend into the weapons station. This fault is considered a major active fault within Contra Costa County. In the period between 1934-1941, there have been at least five earthquakes with Richter Scale magnitudes between between 2.5 and 3.4 which had epicenters on or very close to the weapons station's property. In addition, the Concord fault, which lies just to the west of the station, could produce an earthquake of the magnitude between 5.0 and 6.0 over the next 50 year period.

Hydrology: The drainage systems of the San Francisco Bay Area can be classified as (1) the Great Valley and Delta systems; (2) streams flowing into San Francisco, San Pablo or Suisun Bays; and (3) streams flowing directly into the Pacific Ocean. The Great Valley drainage includes all those streams flowing into the Sacramento and San Joaquin rivers, and drains over 59,000 square miles. Most of the run-off through the watershed is derived from melting snow which creates a flow peak around February. Another peak flow period in April-May is caused by hard seasonal rains.

More than 77 local streams, draining 3450 square miles of watershed, enter San Francisco Bay between the delta and the ocean. Most of the run-off through the streams is derived from rain, resulting in peak flows during the late winter or early spring. Only two major rivers, the Russian and the Gualala, empty directly into the Pacific Ocean.

Flooding is of concern throughout the Bay Area. Historically, major flood problems have occurred in urban areas located in relatively flat valleys near the mouths of rivers. Major seasonal storms coinciding with high tides have resulted in severe property damage. In general, areas less than nine feet above mean sea level are subject to tidal flooding.

Adequate fresh ground water is available throughout the Bay Area. However, high density urbanization and high rates of drawdown create shortages in various communities during the summer months. Additionally, high drawdown rates can result in salt water intrusion into localized aquifers.

Naval Weapons Station, Concord lies within the Mt.Diablo-Seal Creek Watershed which drains about 36 square miles. The watershed is bounded on the south by the north peak of Mt. Diablo and on the north by Suisun Bay. Streams that drain the watershed have their headwaters on the slopes of Mt. Diablo and flow by way of Mt. Diablo Creek through Clayton

Valley and the weapons station to the outlet at Suisun Bay. From the beginning of the tidal marsh to Suisun Bay, a distance of about two miles, the name of the creek changes to Seal Creek.

Historical records show that flooding occurs in the watershed almost every year. Major floods occurred in 1938, 1952 and 1955. The area of Mt. Diablo Creek between Clayton Canal and Arnold Industrial Highway is not a source of severe overbank flooding because the channel has been deeply incised in that area. The channel downstream of Arnold Industrial Highway becomes progressively smaller and flooding occurs on the Concord Municipal Golf Course, the entrance to the weapons station, Port Chicago Highway and the tidal marsh. Flooding is more frequent in this reach than anywhere else in the watershed.

The water in Suisun Bay is a mixture of fresh and salt water with a resultant salinity ranging from 5 to 8 parts per thousand. The water quality is generally poor with high levels of turbidity and suspended solids.

Biological Systems: The combination of marine, fresh water and terrestrial ecosystems that occur in the San Francisco Bay Area provides a very wide range of habitat types. Some 50 square miles of marshland, 78 square miles of salt producing ponds, 65 square miles of tidal flats, and 400 square miles of open water allow a great diversity of species to inhabit the area.

The marine ecosystem is influenced both positively and negatively by run-off from land and fresh water outlets. The incoming nutrients sustain large crops of micro and macro algae that in turn support the remainder of an intricate food web made up of herbivourous and carnivorous organisms. Sediment loads carried into the Bay tend to smother both plants and animals and to block out the incident light that is required by plants to function. The plants of the marine ecosystem consist predominantly of planktonic diatoms, but marine grasses and salt marsh plants also play a major role.

The fresh water ecosystem is also highly dependent on microform algae as a major food source, but the wetlands and marshes take on a very dominant role in the functioning of this system. Tules, reeds, sedges, and other woody water plans provide food and protection for wildlife and act as substrate stabilizers.

Basically, the vegetation is restricted to extremely drought resistant plant materials that show green coloration only during the winter. For this reason, the landscape lacks a permanent character, except in areas where exotic materials such as the eucalyptus tree have been planted, or where irrigation is practiced.

The San Francisco Bay Area provides food and protective habitat to a variety of fish, bird, and mammal species. The fishery resource includes: (1) transitory species such as striped bass, king salmon, sturgeon, steelhead trout, shark, and juvenile Dungeness crabs; and (2) resident species such as sole, flounder, croaker, perch, shad, shrimp, crabs, clams and some oysters.

The Bay Area is situated in the Pacific Flyway, which extends from South America to the Arctic Circle, and provides a stop-over site for large numbers of waterfowl moving north and south. Seventy-five different species of birds frequent the Bay Area and the waterfowl population fluctuates to numbers as high as 800,000.

The native mammal population has diminished dramatically over the years because of urbanization. The once prevalent beaver, muskrat, and mink have all but been eliminated, and the once large deer herd is now restricted to small pockets of undeveloped lands. Sea lions, harbor seals, and occasional porpoise frequent the waters of various bays.

SECTION 3 - INSPECTION PROCEDURE

An underwater inspection of Piers 3 and 4 at the Naval Weapons Station, Concord, was carried out during the time period May 2 - May 20, 1983. The level of inspection to be carried out as detailed in the scope of work, the type of structure being inspected, on site environmental and structural conditions and past experience, dictated the inspection procedures that were employed on this project.

3.1 LEVEL OF INSPECTION

Levels I, II and III inspections were carried out on the various structures as indicated by on site conditions and the scope of work as defined under Task 2 of this contract. This included visual/tactile inspection techniques, cleaning or removing of biofouling from certain members and nondestructive ultrasonic testing of other members as required. In addition, photographic documentation of typical conditions and/or damage was obtained.

3.2 INSPECTION PATTERN/PROCEDURE

A Level I "rapid swim by" inspection of all perimeter piling and piles in every fifth bent in both Piers 3 and 4 was carried out. The results of the Level I inspection were used to form the basis for the selection of piles subjected to more detailed Level II and III inspections.

The Level II inspection of the concrete piles included the cleaning or removal of biofouling on three sides or faces of each inspected pile to a length of 10 inches to expose the underlying pile for inspection. Inspection sites were selected at the mid intertidal zone and at the mudline. Removal of the marine growth was carried out by the use of short handled scrapers.

A Level III ultrasonic inspection of selected timber piling in both Piers 3 and 4 was also carried out. These piles were tested using the unique B.C. Research developed ULTRASCAN PTM-4 ultrasonic testing instruments. The testing crew consisted of two to three men, diver/inspectors who provided visual observations and scanned the entire surface of the pile with the sonic "probe" and a surface technician who monitored the observations and readings produced on the meter. The probe is attached to the pile by the diver at the water surface. The diver then proceeds to scan the entire length of the pile from the surface to mudline. The instruments provide a continuous cross-sectional area readout which is recorded by the surface technician. When the mudline is reached, the probe is moved onto the adjacent pile in the bent and the process is repeated from mudline to surface. Removal of fouling is not required for operation of the unit. The pile "ratings" are given in terms of undamaged cross-sectional area remaining in each pile. These ratings are based on the least cross-sectional area found as revealed by sonic and visual data. The ratings are given in quartiles and indicate both the location and degree of loss of pile cross-section in damaged piles.

Based on the data provided, the new L/d ratio of a pile can be established in light of damage found. The L/d ratios and the reduced pile capacities of the damaged piles are provided in Tables 3 and 6, pages T5 and T21.

The ULTRASCAN is used to detect and assess marine borer and mechanical damage in the immersed areas of the pile from mudline to the high tide level. Additional inspection is carried out from the high tide level to the cap to locate any possible mechanical and fungal damage.

3.3 EQUIPMENT

- ULTRASCAN PTM-4 *, timber pile testing instruments.
- Underwater telephone.
- Nikonos IV-A Camera and Strobe.
- Clearwater box for underwater photography.
- Short handled scrapers for cleaning concrete piles.
- Steel rulers for measurement of extent of deteriorated concrete.
- Miscellaneous ancillary equipment and SCUBA gear.

3.3.1 Background on Ultrasonic Instrumentation

3.3.1.1 ULTRASCAN PTM-4

The ULTRASCAN PTM-4 pile testing instruments are the result of studies initiated at B.C. Research in 1955, to develop instruments for nondestructive testing of inplace marine piling. It was found that the velocity and strength of sound waves passing through wood varied inversely with voids in wood caused by marine borers. Based on this principle, instruments were developed which use magnetostrictive transducers to provide an ultrasonic scan of the pile. The plane waves which penetrate the wood, from the transmitting transducer, initiate transmission of secondary sonic patterns in the direction of the wood grain. As these waves transit along the axis of the pile they produce radial sets of waves which are picked up by the transducer. Undamaged wood is an excellent transmitter of these waves, whereas damaged wood attenuates the sound. During the development stage extensive axial load testing of pile sections was carried out and correlations were established between the sonic readings and the remaining undamaged cross-section of the pile. A direct meter readout is provided

* Patented

showing the percentage of sound wood remaining. Verification and refinement of the initial methods has been carried out by testing inplace piling, removing the piles and subjecting them to inspection and axial load testing. Good correlation was found between the sonic readings, the remaining undamaged area of the pile and the strength ratings based on the sonic instruments.

3.3.2 Reasons for Selection of ULTRASCAN PTM-4 Instrumentation

Bankia damage in piling can only be determined by underwater inspection, with many attendant difficulties. If the *Bankia* are alive and the siphons extended, recognition is not too difficult. If the siphons are retracted or the *Bankia* are dead, detection of the burrow openings is not easy. In many instances, fouling must be scrubbed off the piling in order to facilitate an inspection. If visibility is limited, as frequently occurs in industrial locations, visual inspection is hopeless. Even if teredine entry holes are observed, an evaluation of internal damage, by purely visual means, is not possible.

Because of these difficulties, the sonic testing method was initially developed to locate and evaluate teredine damage. It was felt that *Limnoria* damage could be readily detected visually, since the damage progressed from the surface inward. Experience, however, has shown that the sonic testing method substantially enhances the detection and evaluation of damage even in areas where *Limnoria* is the primary source of infestation. Some of the reasons for this are as follows:

1. In areas with poor or nonexistent underwater visibility, sonic testing expedites the examination by locating the damage and providing for a quantitative evaluation of the residual strength.

2. *Limnoria* attack very often takes the path of least resistance. That is, *Limnoria* will gain access into a pile through a small breach in the creosoted layer and destroy the untreated heartwood with very little surface evidence of damage. A good example of this is a U.S. Navy fuel pier. In this particular structure a considerable number of piles, which have been destroyed by *Limnoria*, show no obvious visual indication of damage. The reason for this is that the *Limnoria* has gained access to the pile through open boltholes. The boltholes are virtually impossible to detect unless all fouling is removed from the pile and a minute visual examination is carried out. This type of visual examination would be very time consuming and costly. It would be further restricted by poor underwater visibility.

3. *Limnoria* damage, particularly in Californian waters, very often exposes the treated pile to teredine attack which would be very difficult to detect and assess visually.

3.4 PERSONNEL ON PROJECT

Jerry Agi	- Project Manager
Erling Vegsund	- Project Supervisor
Scott Christie	- Engineering Technician
Fred Phillips	- Technician/Draftsman
Allan Jones	- Computer Analysis
Douglas Cassidy	- Computer Analysis
Maria Sjoquist	- Report Preparation

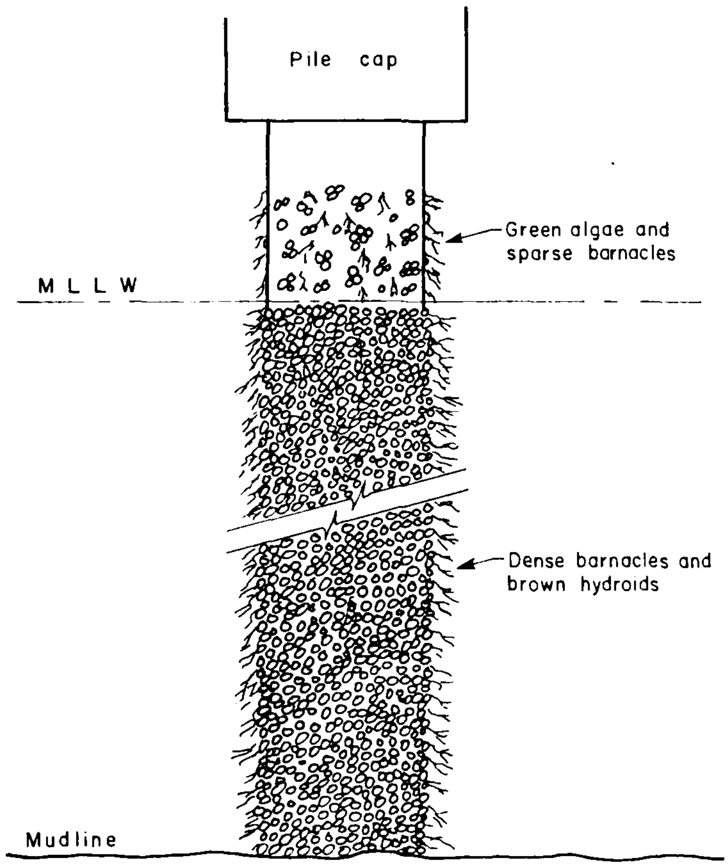
SECTION 4 - FACILITIES INSPECTED

Each of the two facilities at the Naval Weapons Station, Concord is referred to separately in this section of the report. The sequence of the presentation of the inspected structures is Pier 3 followed by Pier 4. The discussion of each facility is presented in four sections: (1) A description of the overall facility and its operations as well as a specific detailing of the construction and identification of the examined piles; (2) a detailing of the observed condition of the facility as determined by the field inspection; (3) a quantitative assessment of the structural condition of the facility based on the observed condition; and (4) recommendations for maintenance to ensure the structural integrity of the facility. Tables detailing the condition of the inspected piles as well as cost breakdowns for any necessary repairs are included in the accompanying appendices.

Marine growth or fouling profiles were found to be similar for both structures. Organisms found consisted mainly of barnacles and hair like brown hydroids as well as green algae. The fouling organisms were found to range from the upper intertidal zone to the mudline. Specifically they were found to range as follows:

Upper intertidal zone:	green algae sparse barnacles
Mid intertidal zone:	moderate to dense barnacles and brown hydroids
Lower intertidal zone to mudline:	dense barnacles and brown hydroids.

The following Figure No.1 and Photographs 1 - 5 serve to illustrate the typical fouling organisms found throughout the inspected structures.



J. Agi & Associates Co. Ltd. Suite 600, 1414 Alaskan Way, Seattle, WA	CHES DIV NAV FAC ENG COM	
	MARINE GROWTH PROFILE NAVAL WEAPONS STATION CONCORD, CA	**Fig. 1**
Not to scale — June 1, 1983		

PHOTOGRAPH No. 1

Fouling profile - Green algae and sparse barnacles in upper intertidal zone.

PHOTOGRAPH No. 2

Fouling profile - Moderate to dense barnacle and brown hydroid growth in mid-intertidal zone.

PHOTOGRAPH No. 3

Lower intertidal zone.

PHOTOGRAPH No. 4

Submerged zone.

PHOTOGRAPH No. 5

Submerged zone and mudline.

Photographs 3, 4 and 5. Fouling profile - Dense barnacle and brown hydroid growth from lower intertidal through the submerged zone to the mudline. Fouling was removed from center of pile to show the density of the marine growth.

4.1 PIER 3

4.1.1 Description

Pier 3 is located between Piers 2 and 4 at NWSC. The Pier has two berths, numbers 3 and 4 which service ocean going AE ships. The Pier is serviced both by vehicular and rail traffic.

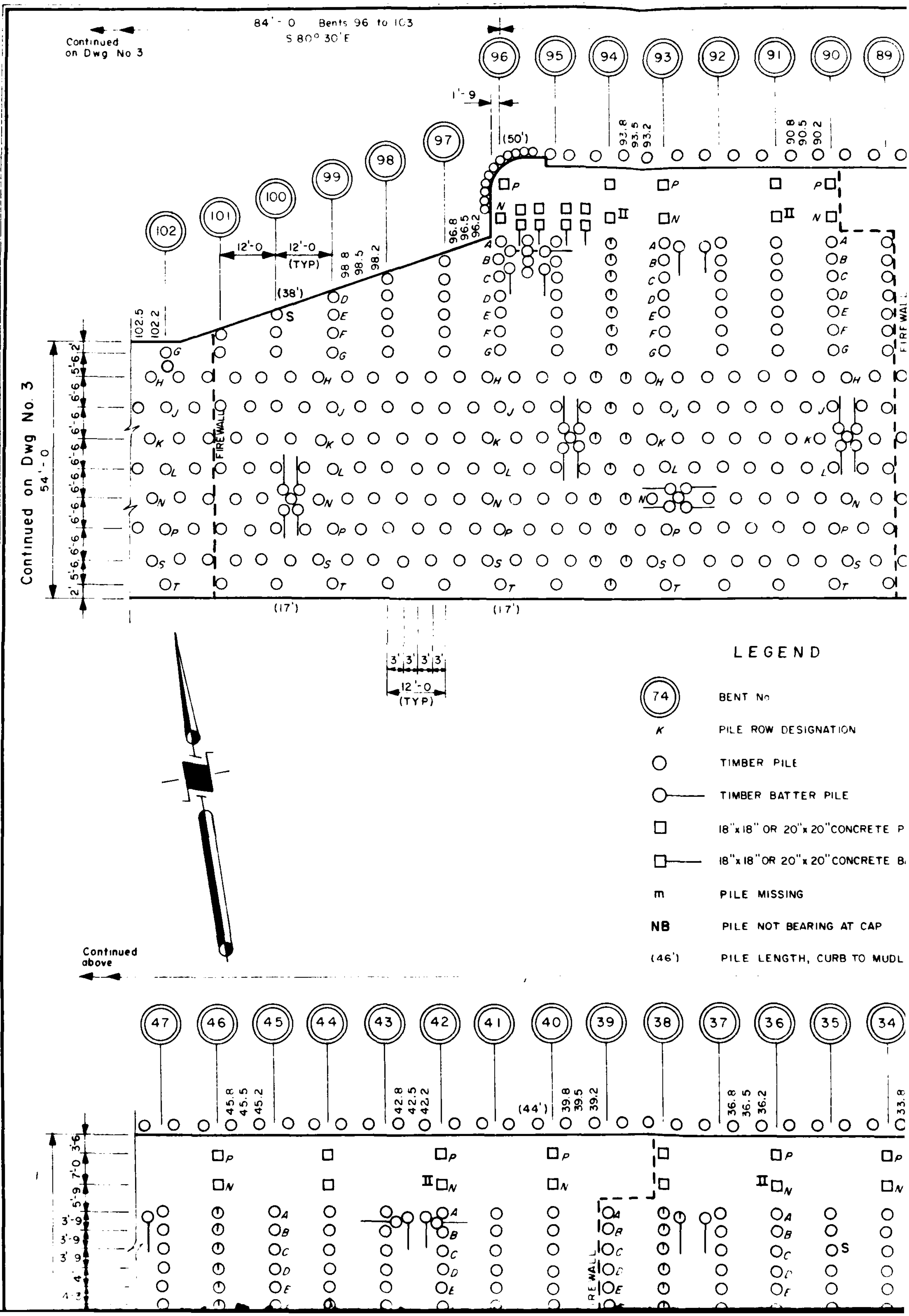
The Pier was originally constructed in 1944 on creosote treated timber piling with a timber cap, stringer and deck superstructure. The original configuration of the pier was crescent shaped with an approach trestle extending from the shore to an expanded width pierhead. A timber walkway or access trestle served to provide light vehicle and pedestrian traffic to the pierhead. In 1966 major modifications to the facility were carried out. These changes included the widening of the pierhead section and the installation of a second approach trestle continuous with the eastern end of the pierhead. Once completed, the new trestle allowed for a one way roll-on/roll-off traffic pattern. The section of the structure added in 1966 was constructed on prestressed concrete piles.

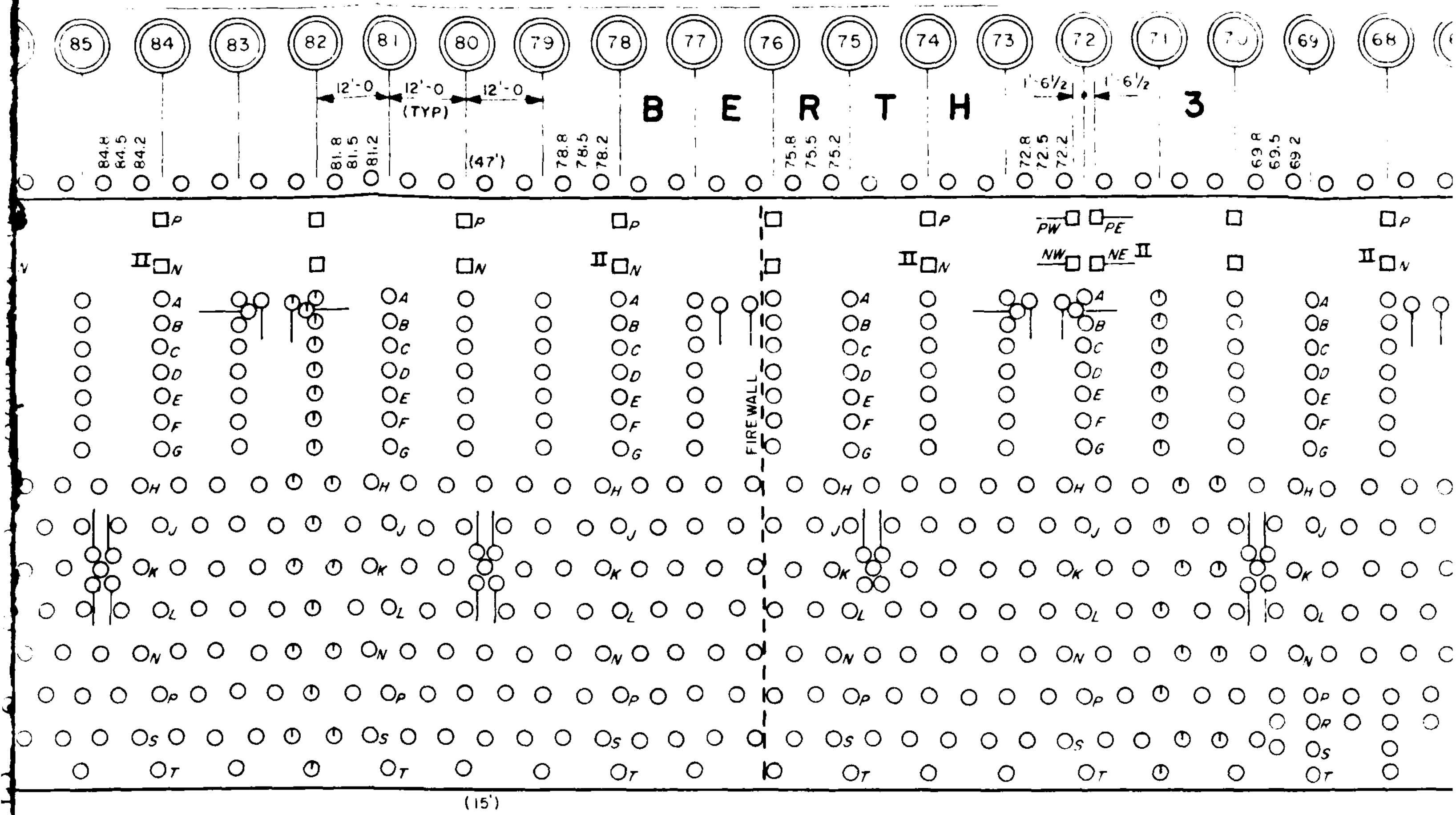
For the purposes of this inspection, the structure was subdivided into four sections. As shown in drawings 2 - 6, these sections are identified as the (1) Pierhead (photograph No.6); (2) Approachway Trestle; (3) Access Trestle (photograph No.7); and (4) Concrete Trestle (photograph No.8), For identification purposes, the piles within each of these sections have been designated bent and row numbers based on the identification system used on NAVFAC reference drawings: 11242-B1; 11242-B2; 11242-8; 11242-9; 1115145 and 1115132.

Pile lengths along the berth face in the pierhead section were found to be approximately 40 feet, mudline to cap. Measurements of pile lengths were taken at intervals throughout the facility. These lengths are detailed in the accompanying drawings. In several areas, extensive silting of the mudline has occurred resulting in shallow water.

The timber pile diameters were found to average approximately 12". As detailed on Drawing No. 5, the concrete piles are either 20" or 18" square depending on their location within the structure.

At the time of the inspection, the underwater visbility ranged from zero to a maximum of 1 foot. Current conditions at the site ranged from minimal at slack tide to approximately 3 knots during the ebb tide.


84'-0 Bents 96 to 103
S 80° 30' E
Continued on Dwg No 3
Continued on Dwg No. 3
54'-0
12'-0
12'-0 (TYP)
(38')
(50')
(17')
(17')
1'-9
3' 3' 3' 3'
12'-0 (TYP)
FIREWALL
FIRE WALL
LEGEND
74 BENT No
K PILE ROW DESIGNATION
TIMBER PILE
TIMBER BATTER PILE
18"x18" OR 20"x20" CONCRETE P
18"x18" OR 20"x20" CONCRETE B
m PILE MISSING
NB PILE NOT BEARING AT CAP
(46') PILE LENGTH, CURB TO MUDL
Continued above
(44')
FIRE WALL

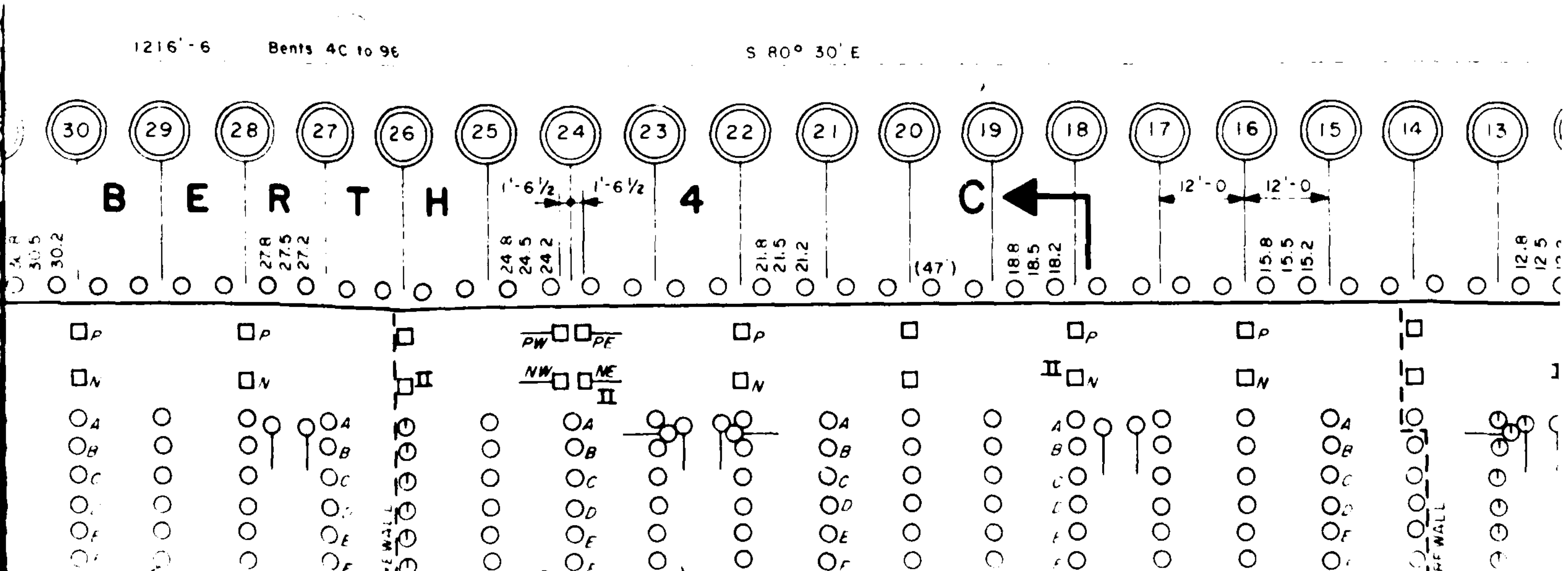


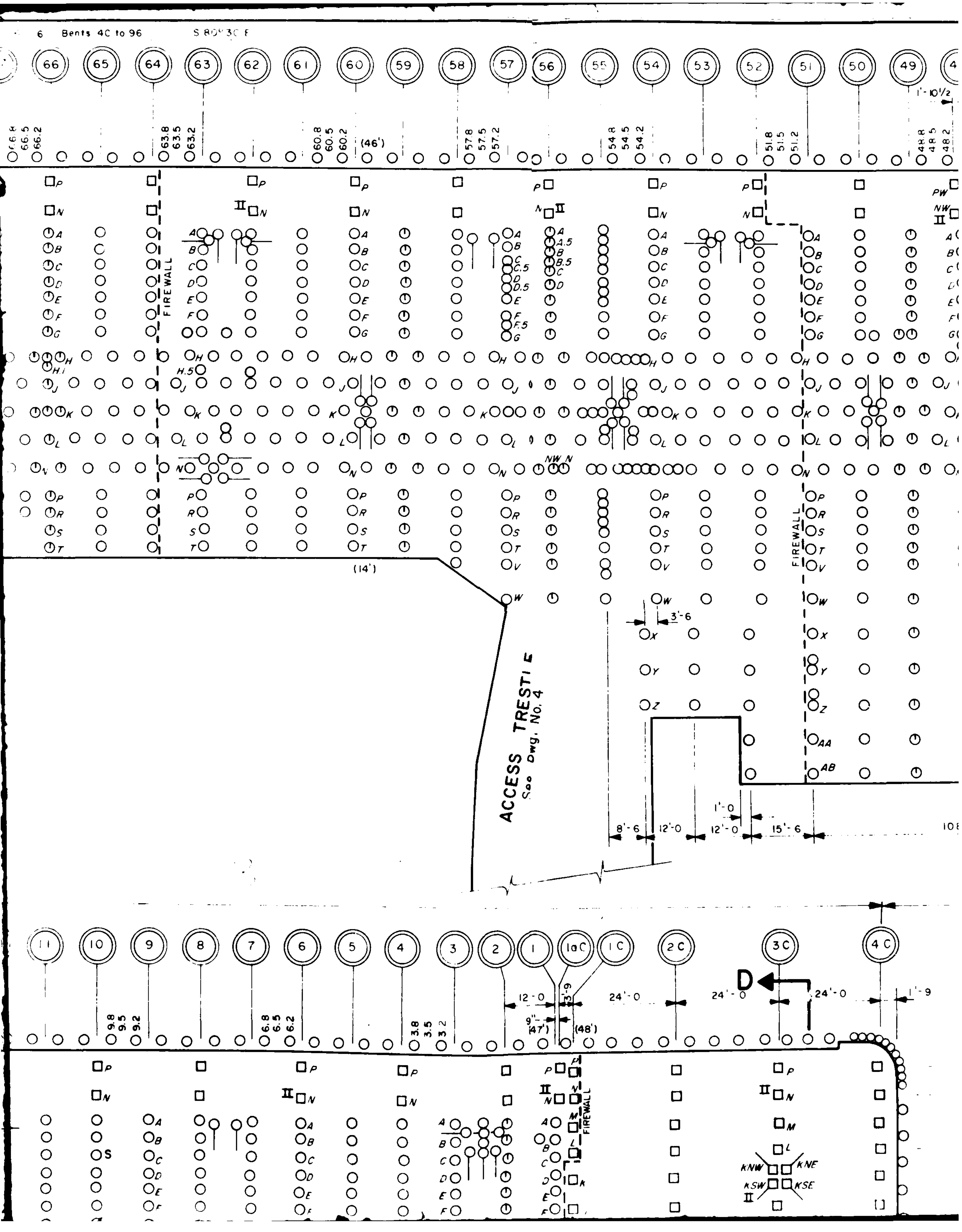
INSPECTION LEVEL DESIGNATIONS

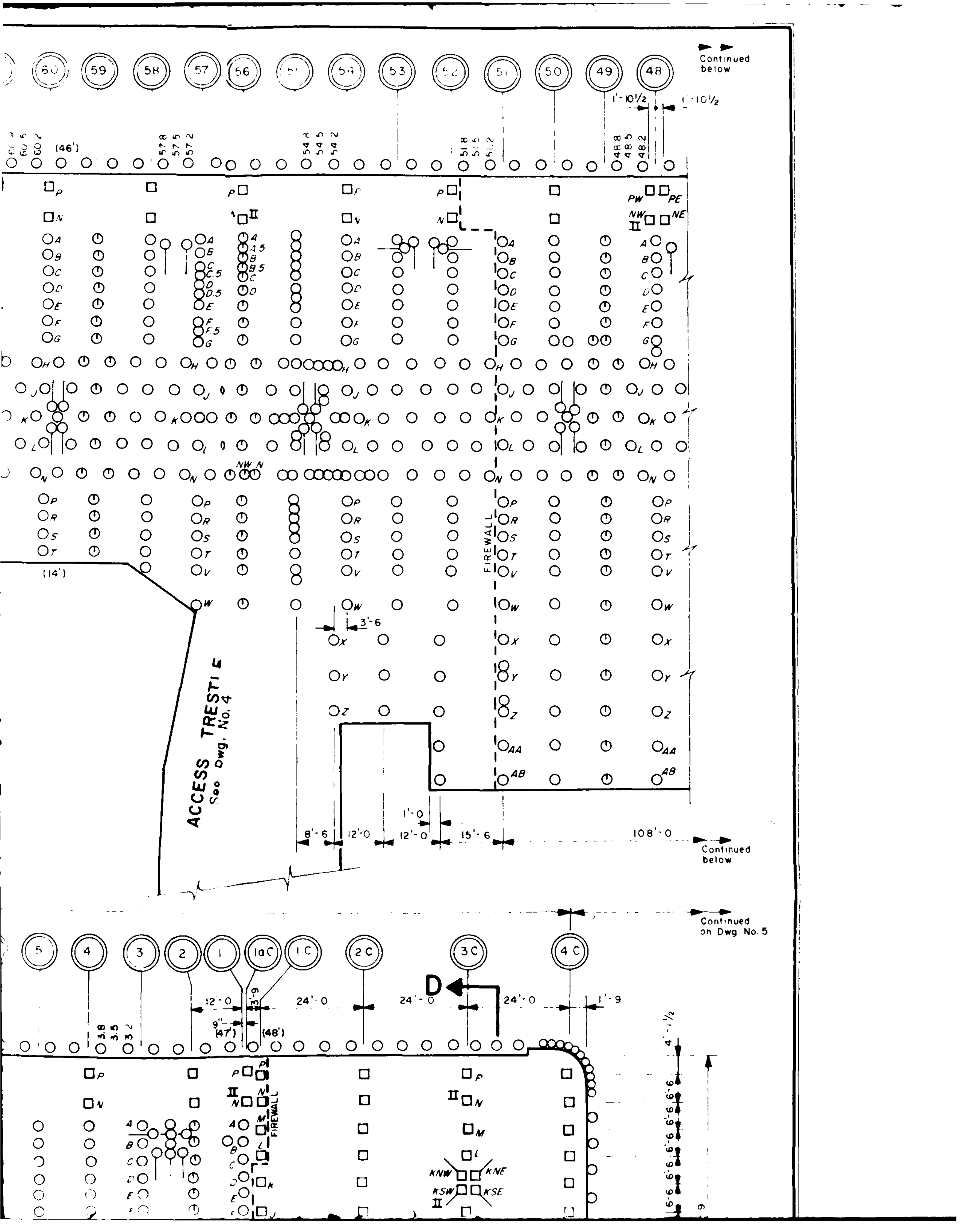
LEVEL I - all perimeter piles from bents 4C to 102
- all piles in every fifth bent, i.e. 1, 5, 10, 15 etc. to 90 and 100, and bent 1C
S - SIGNIFICANTLY DAMAGED PILE

LEVEL II - inspected piles indicated by (II)
✱ - SIGNIFICANTLY DAMAGED PILE

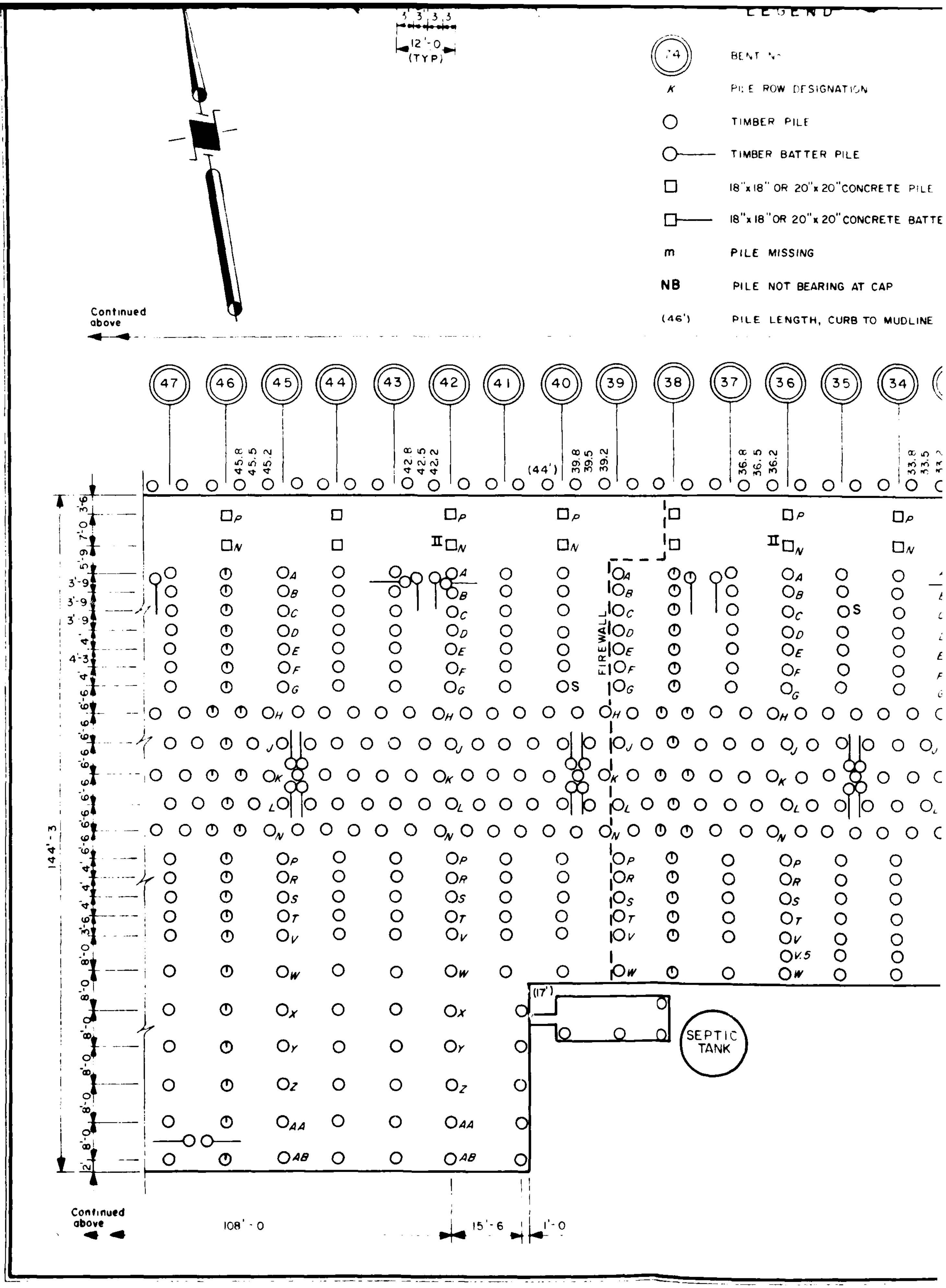
LEVEL III - inspected piles indicated by ;
- 100% REMAINING CROSS-SECTIONAL AREA
- 75% REMAINING CROSS-SECTIONAL AREA
- 50% REMAINING CROSS-SECTIONAL AREA
- 25% REMAINING CROSS-SECTIONAL AREA
- 0-25% REMAINING CROSS-SECTIONAL AREA




6 Bents 4C to 96
S 80°30' E
66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49
66.8 66.5 66.2
63.8 63.5 63.2
60.8 60.5 60.2
(46')
57.8 57.5 57.2
54.8 54.5 54.2
51.8 51.5 51.2
48.8 48.5 48.2
1'-10 1/2
FIREWALL
(14')
3'-6
ACCESS TRESTLE
See Dwg. No. 4
8'-6
12'-0
12'-0
1'-0
15'-6
11 10 9 8 7 6 5 4 3 2 1 1aC 1C 2C 3C 4C
D
12-0
3'-9
24'-0
24'-0
24'-0
1'-9
9"
(47')
(48')
9.8 9.5 9.2
6.8 6.5 6.2
3.8 3.5 3.2
KNW KNE KSW KSE



Continued below
59
58
57
56
54
53
50
49
48
1'-10½
1'-10½
(46')
57.8
57.5
57.2
54.5
54.2
51.8
51.5
51.2
48.8
48.5
48.2
PW
PE
NW
NE
FIREWALL
(14')
3'-6
ACCESS TRESTLE
See Dwg. No. 4
1'-0
8'-6
12'-0
12'-0
15'-6
108'-0
Continued below
Continued on Dwg No. 5
5
4
3
2
1
1aC
1C
2C
3C
4C
D
12'-0
3'-9
24'-0
24'-0
24'-0
1'-9
9"
(47')
(48')
3.8
3.5
3.2
4'-1½
FIREWALL
KNW
KNE
KSW
KSE
6'-6



LEGEND
BENT Nº
PILE ROW DESIGNATION
TIMBER PILE
TIMBER BATTER PILE
18"x18" OR 20"x20" CONCRETE PILE
18"x18" OR 20"x20" CONCRETE BATTE
m PILE MISSING
NB PILE NOT BEARING AT CAP
(46') PILE LENGTH, CURB TO MUDLINE
12'-0 (TYP)
Continued above
47 46 45 44 43 42 41 40 39 38 37 36 35 34
FIREWALL
SEPTIC TANK
(17')
(44')
144'-3
108'-0
15'-6
1'-0
Continued above

INSPECTION LEVEL DESIGNATIONS

LEVEL I - all perimeter piles from bents 4C to 102
- all piles in every fifth bent, i.e. 1, 5, 10, 15 etc. to 90 and 100, and bent 1C
S - SIGNIFICANTLY DAMAGED PILE

LEVEL II - inspected piles indicated by (II)
✱ - SIGNIFICANTLY DAMAGED PILE

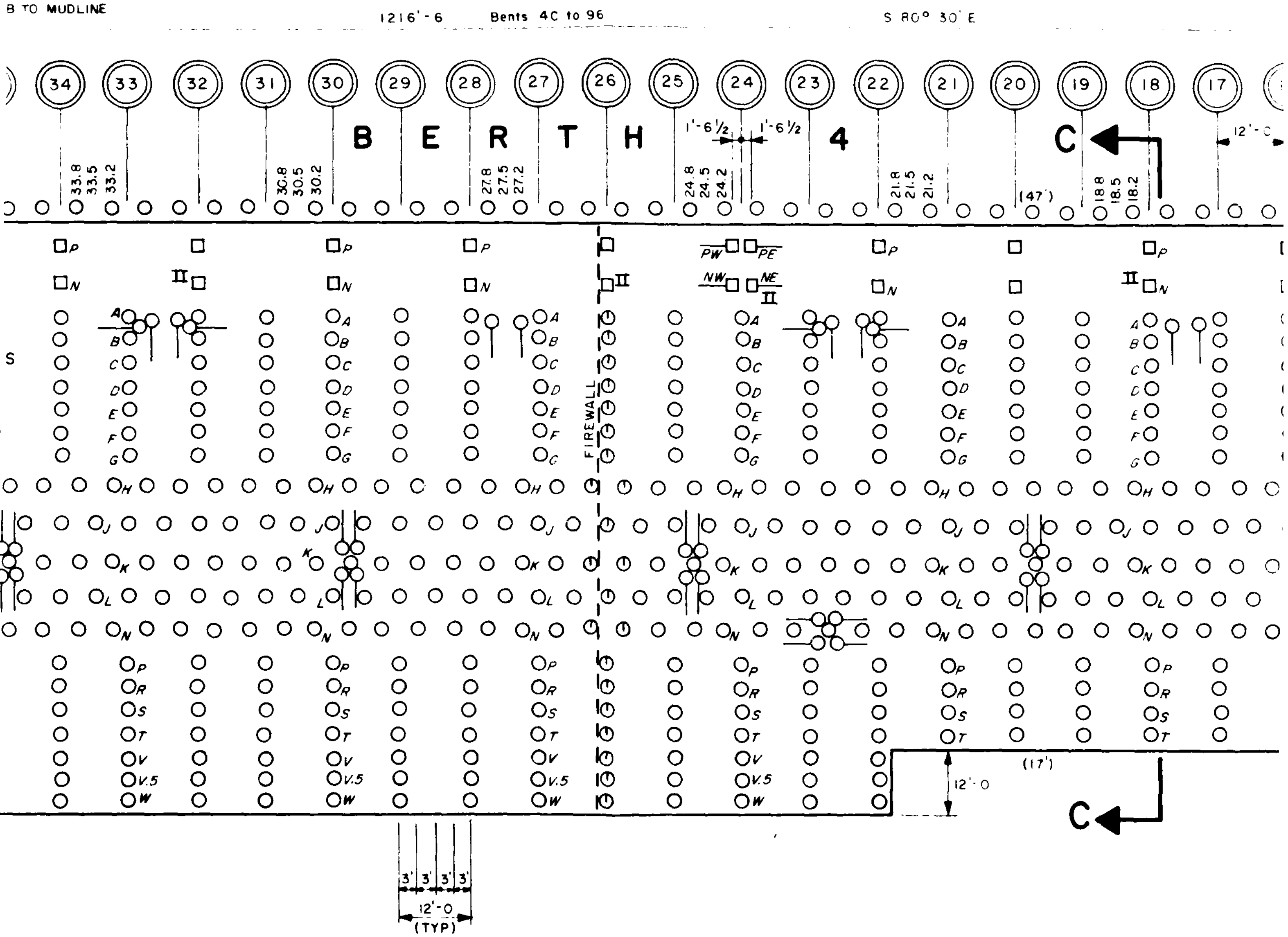
LEVEL III - inspected piles indicated by ;
- 100% REMAINING CROSS-SECTIONAL AREA
- 75% REMAINING CROSS-SECTIONAL AREA
- 50% REMAINING CROSS-SECTIONAL AREA
- 25% REMAINING CROSS-SECTIONAL AREA
- 0-25% REMAINING CROSS-SECTIONAL AREA

NCRETE PILE

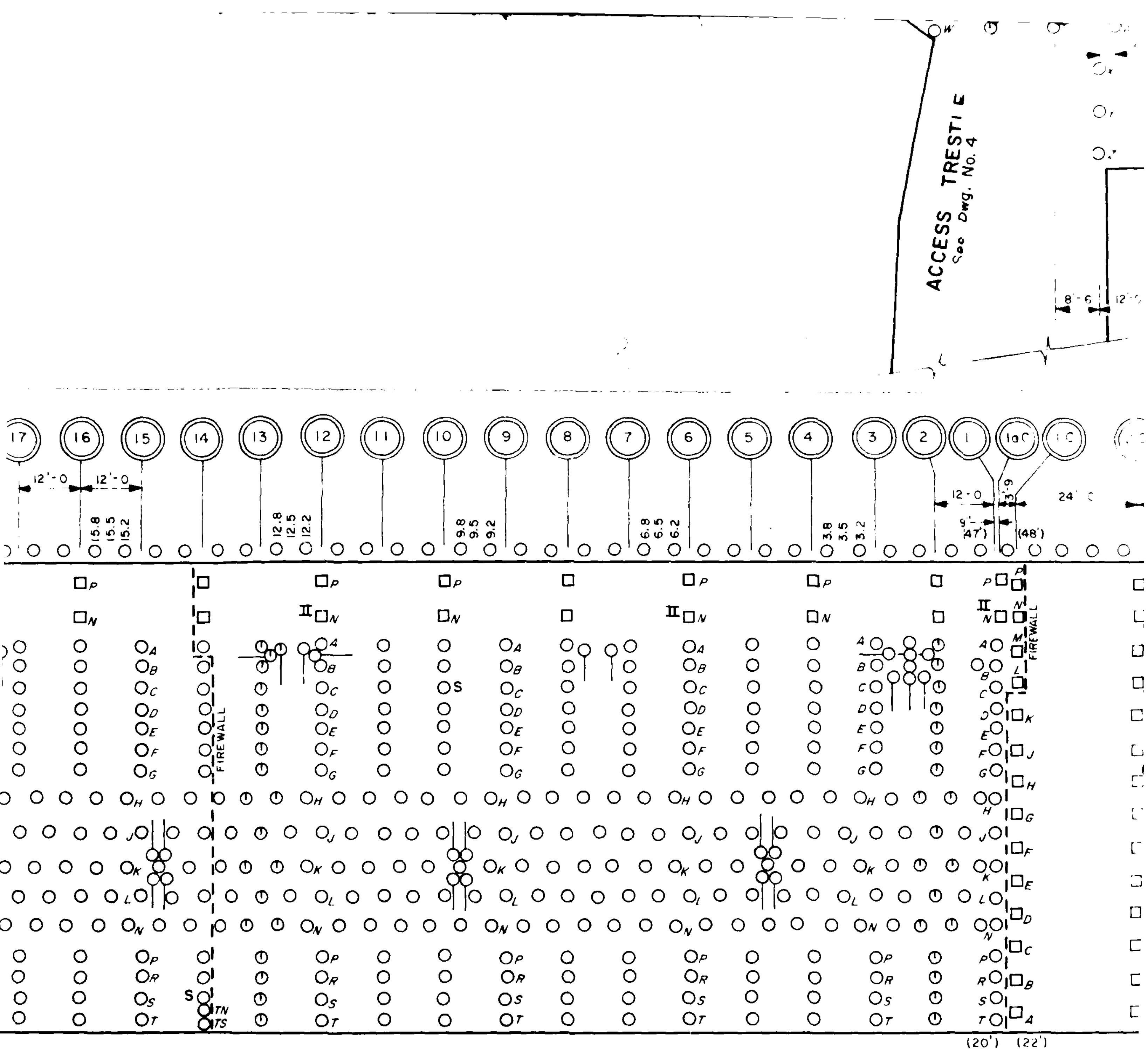
NCRETE BATTER PILE

AT CAP

B TO MUDLINE



Not



PIER 3, Reference Drawings
P.W. Dwg. No
11242-B1
11242-B2
11242-8
11242-9
Y and D Dwg. No
1115132
1115145
1115148
Navfac Dwg No
1045971

Note: 18" concrete piles, bents 1aC to 96C
20" concrete piles, bents 1C to 4C

J. AGI & A
Suite 600, 14

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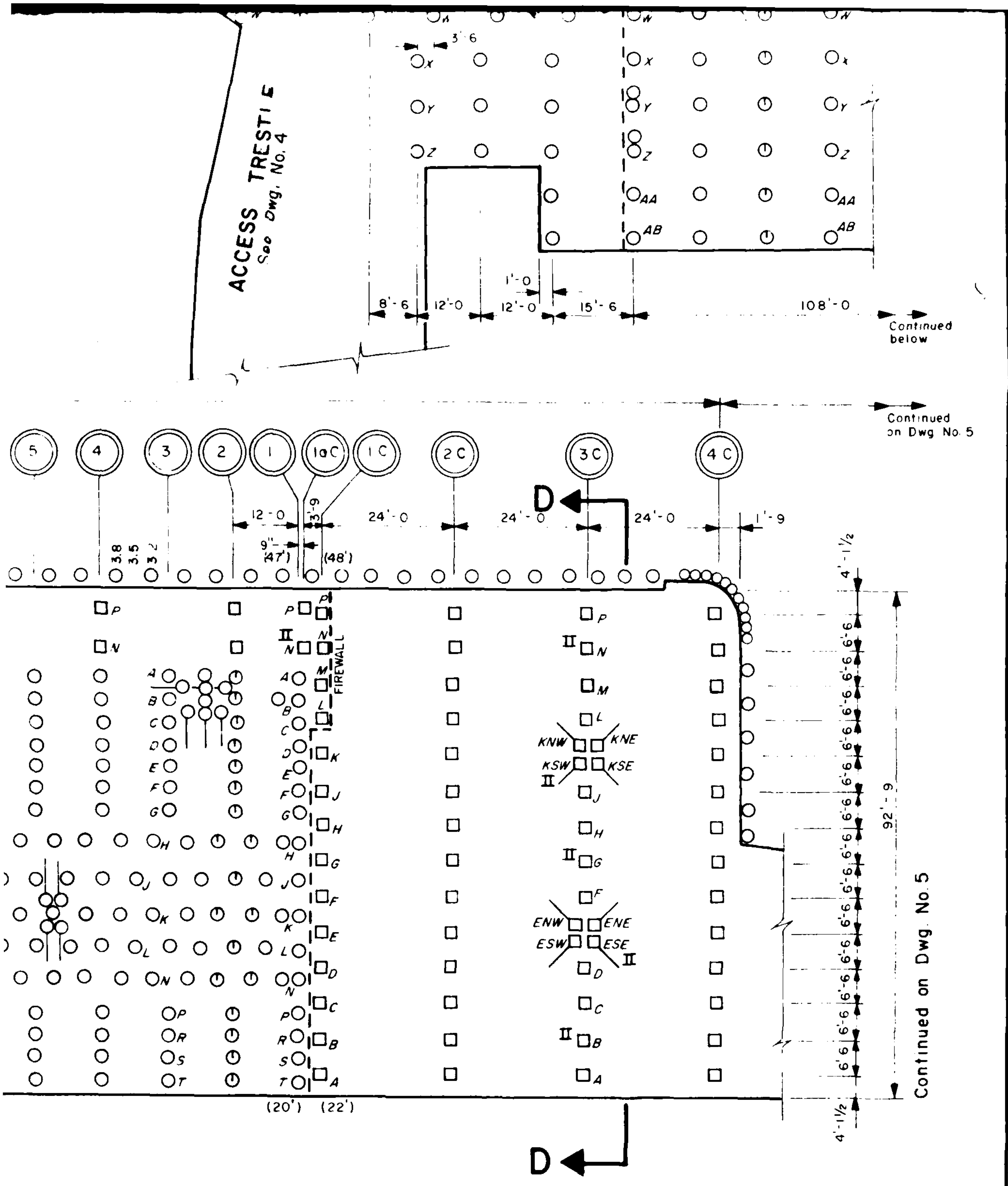
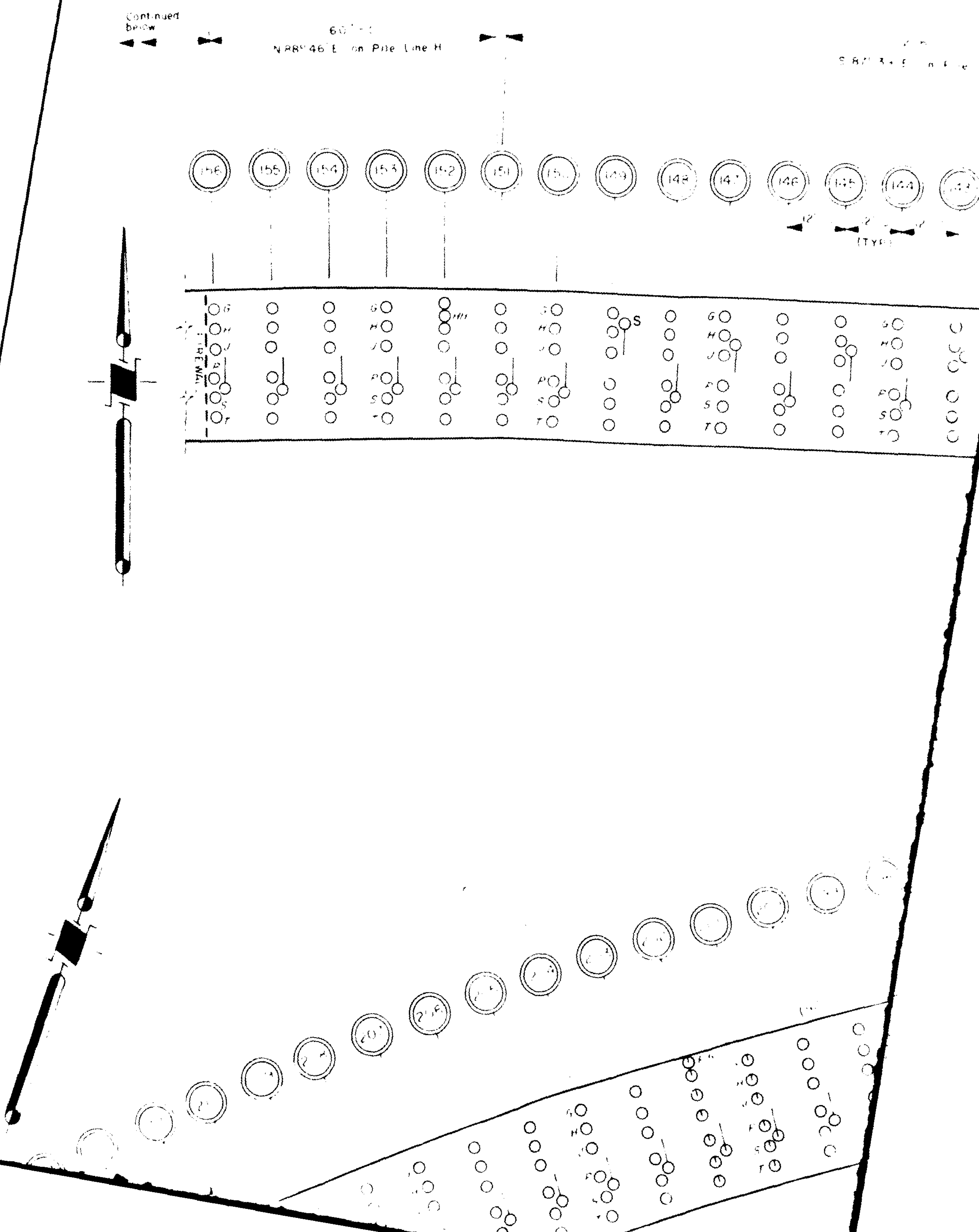
CO

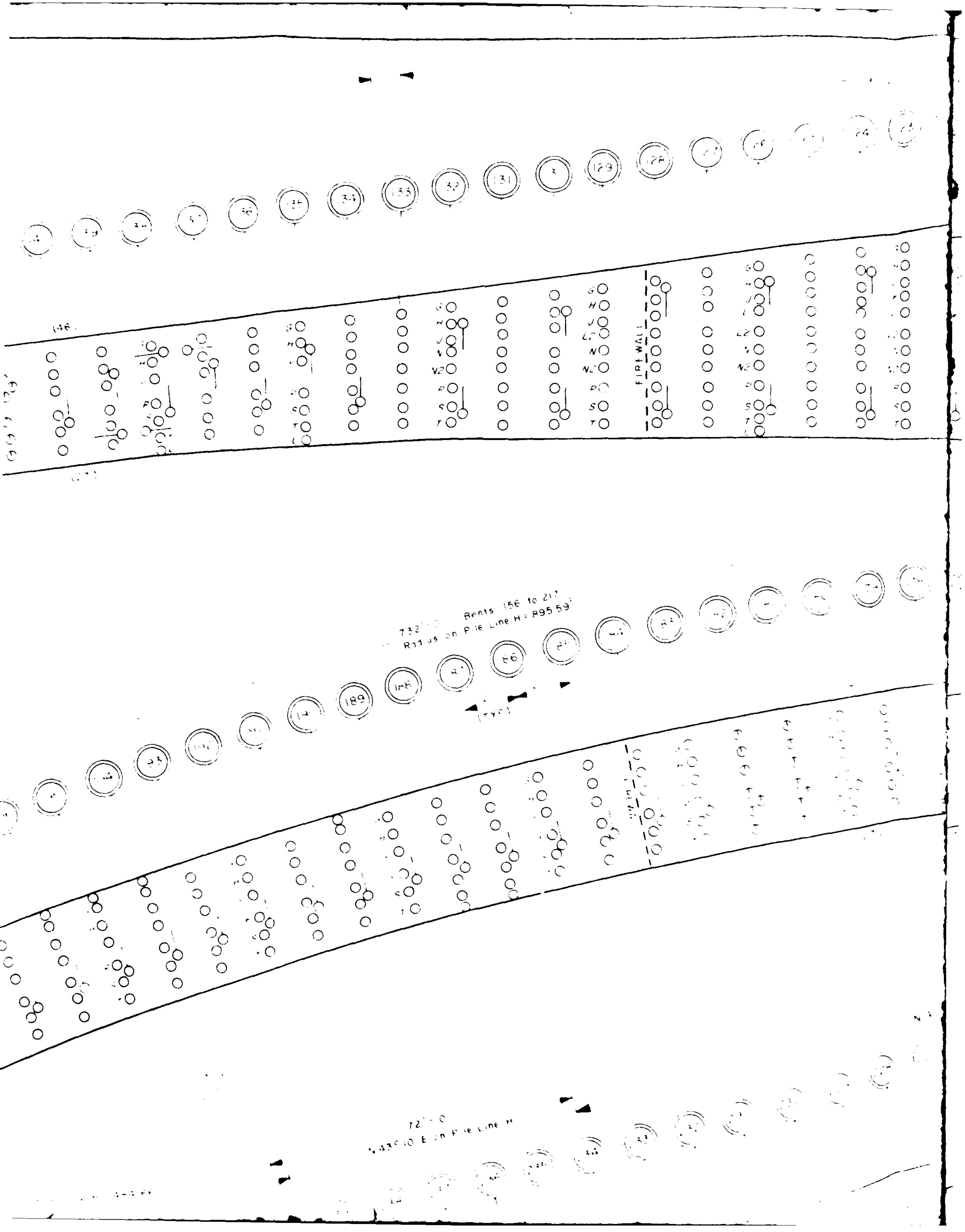
CHES
REPOR
CONTRAC



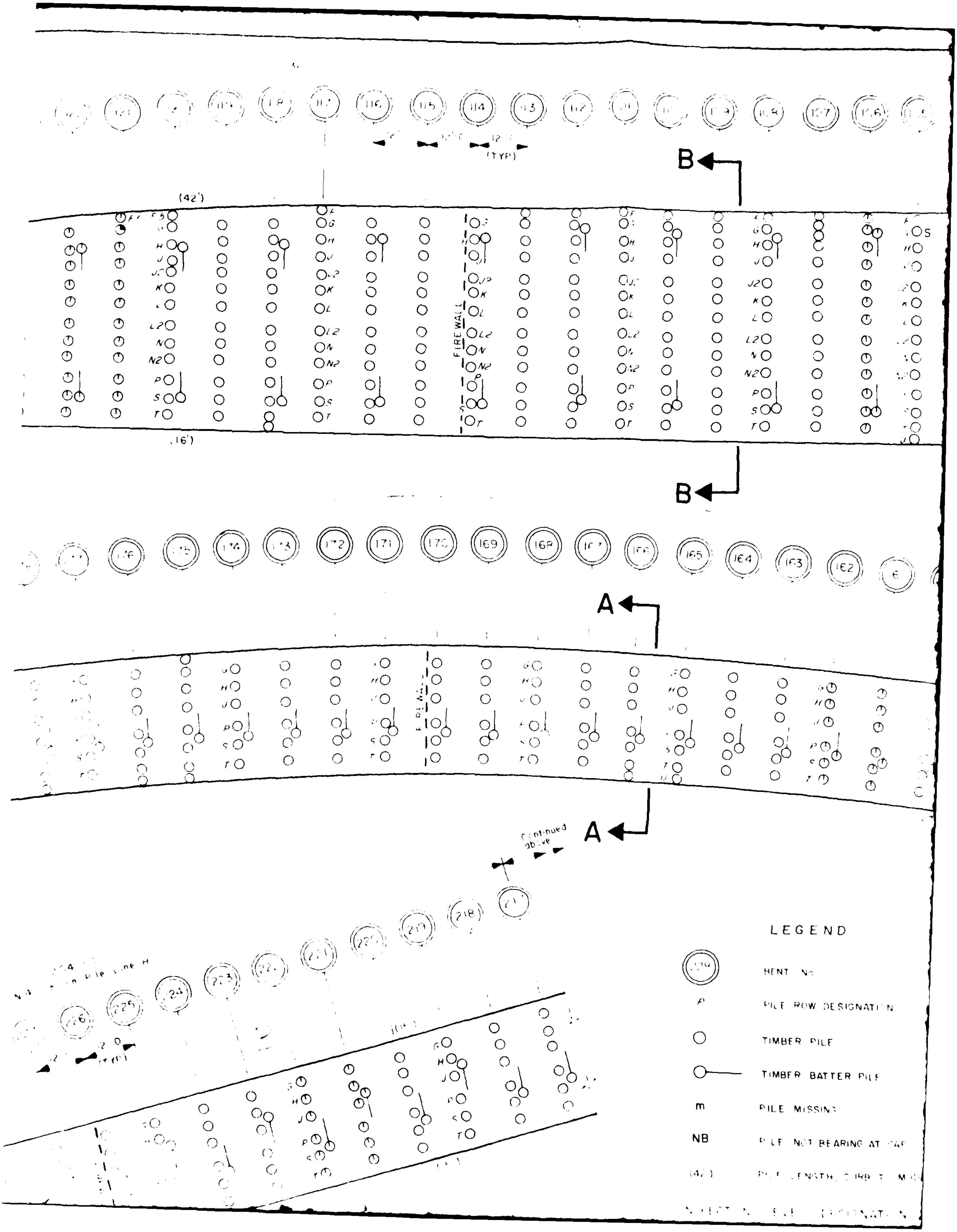
Drawings

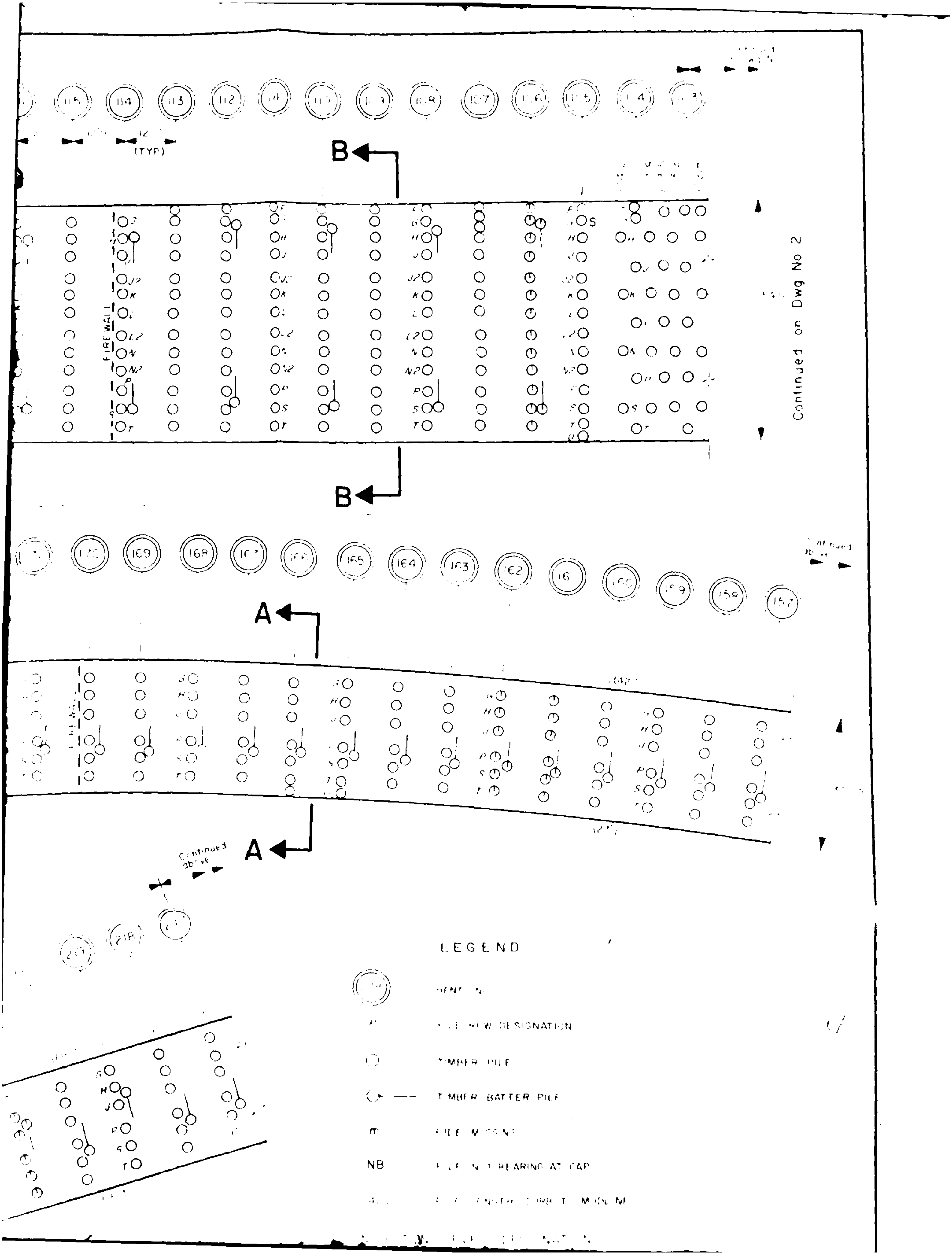
J. AGI & ASSOCIATES CO. LTD. Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE 1" = 20'
	DRAWN F P
PLAN SHOWING LOCATION AND CONDITION OF INSPECTED PILING IN PIER 3, PIERHEAD U.S. NAVAL WEAPONS STATION CONCORD, CALIFORNIA	CHECKED J.P.
CHES DIV NAV FAC ENG COM REPORT No. FPO-1-83-(19) CONTRACT No N62477-81-C-0498 TASK 2	APPROVED KIE
	DATE JUNE 6, 1983.
DWG No. 2	PROJECT No **83-1/3-2-100**

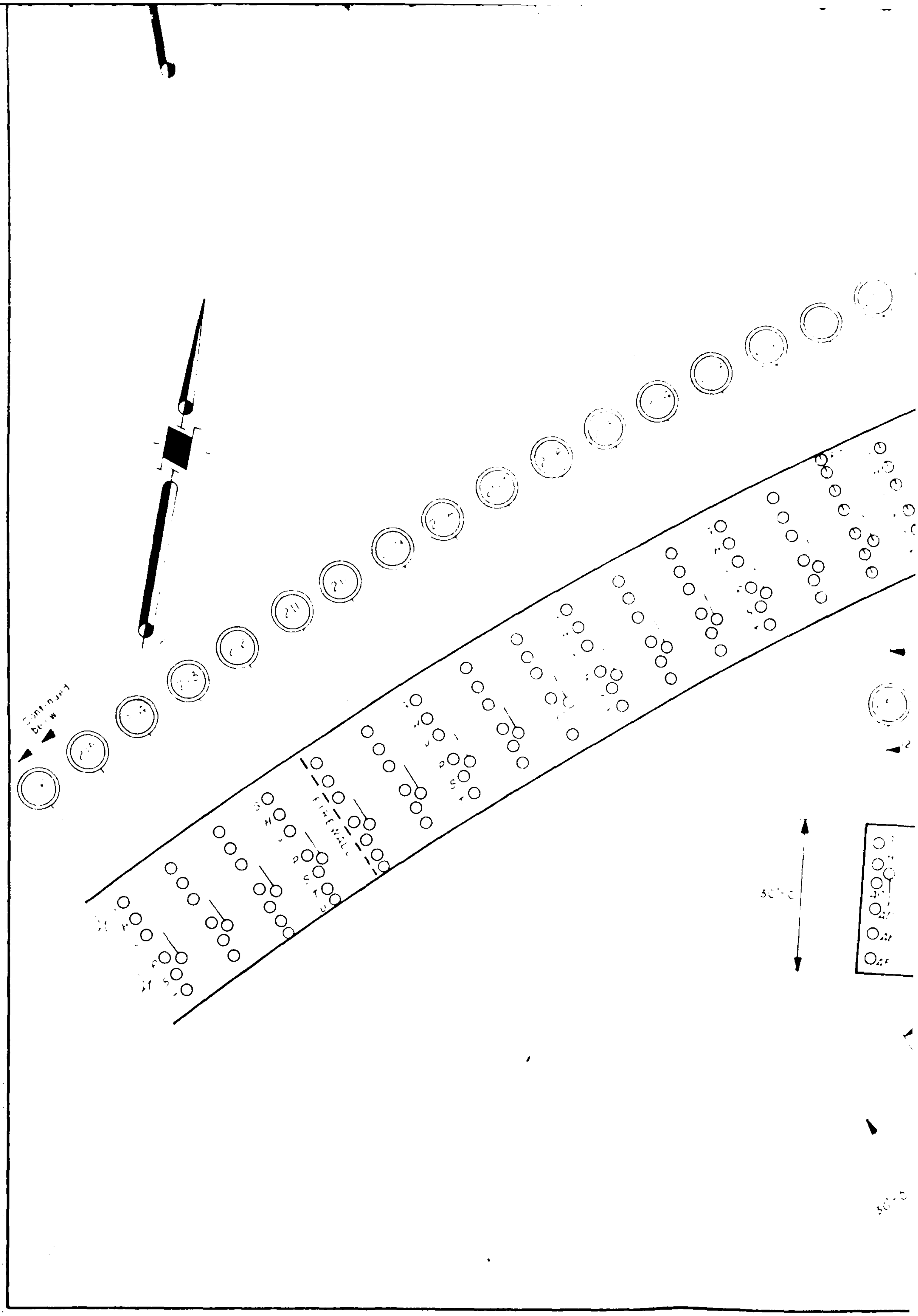

Continued below
N 88°46' E on Pile Line H
156
155
154
153
152
151
148
146
144
(TYP)
TERMINAL

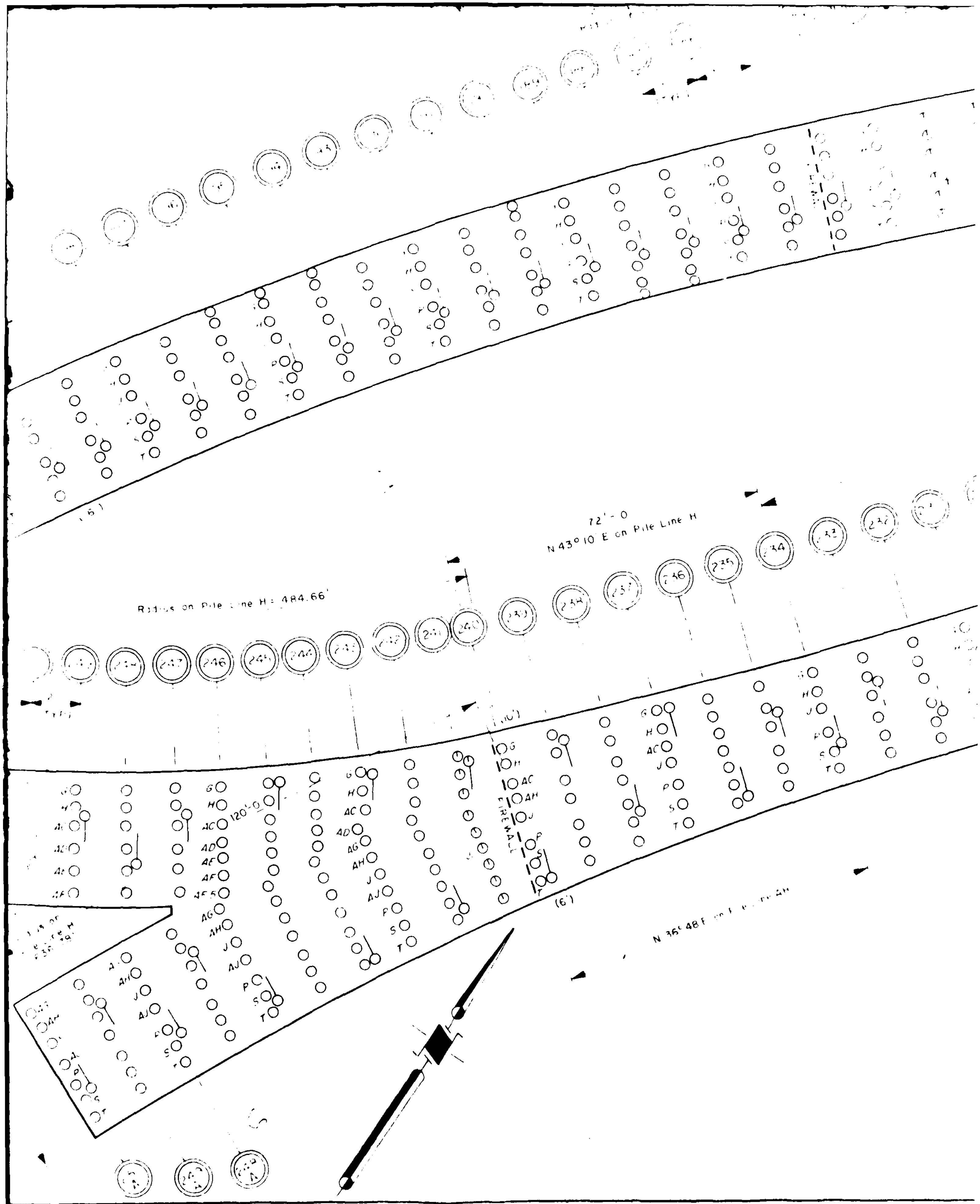


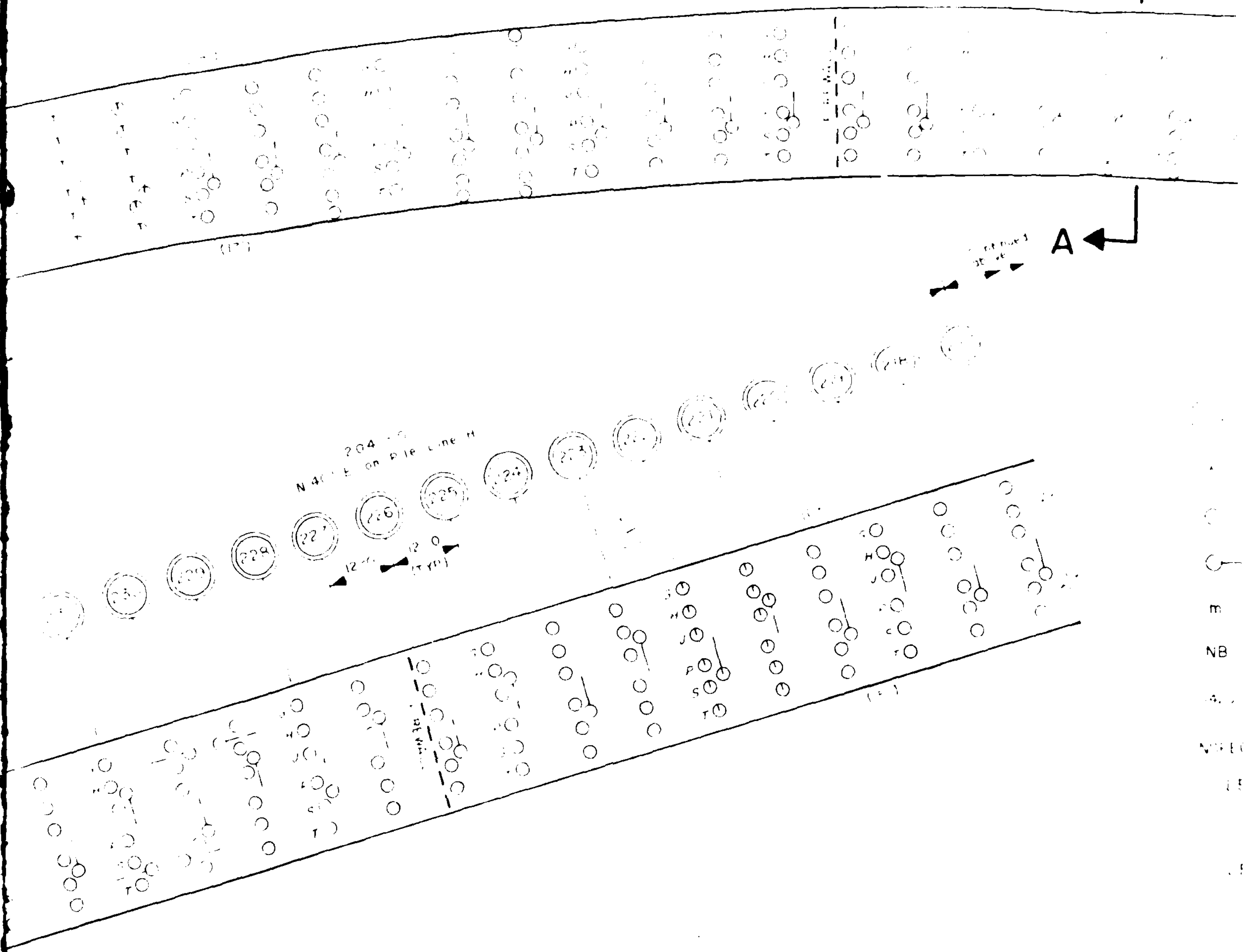
146
129
131
133
132
FIRE WALL
G
H
J
N
N2
P
S
T
Bents 156 to 217
Radius on Pile Line H = 895.59'
189
186
93
(TYP)


B
B
A
A
FIRE WALL
(42')
(TYP)
Continued above
LEGEND
TIMBER PILE
TIMBER BATTER PILE
PILE MISSING
NB
PILE ROW DESIGNATION
m


B
B
A
A
(TYP)
FIRE WALL
Continued on Dwg No 2
Continued above
LEGEND
TIMBER PILE
TIMBER BATTER PILE
NB



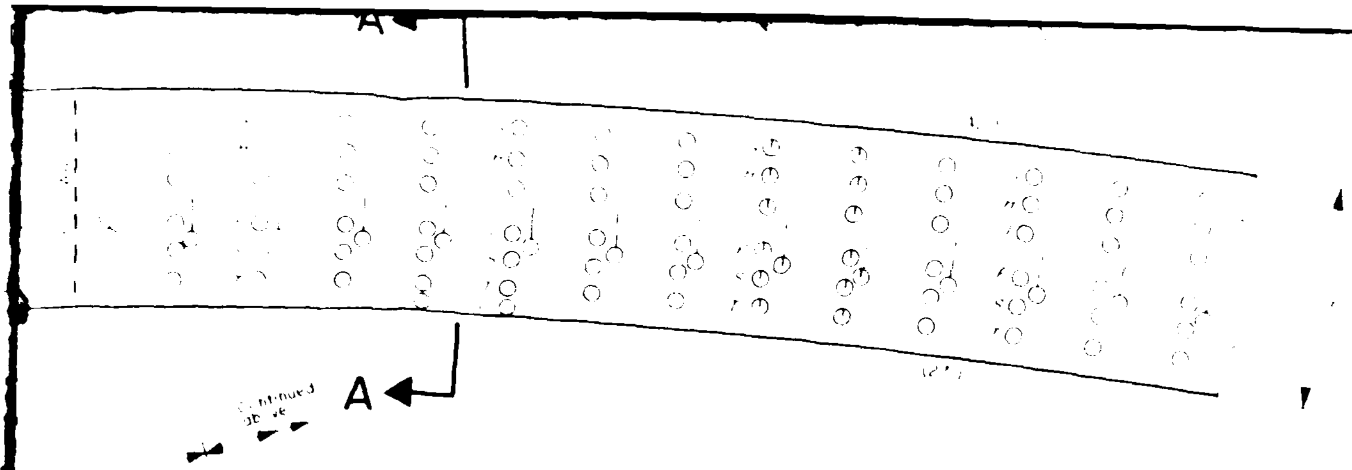

72'-0
N 43° 10' E on Pile Line H
Radius on Pile Line H = 484.66'
236
235
234
120'-0
FIREWALL
(6')

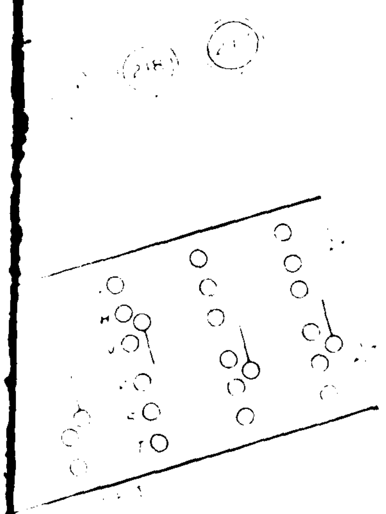


J. AGI
Suite 6

AND CO
PIE
U.

F
CON





LEGEND

BENT No.

P PILE ROW DESIGNATION

TIMBER PILE

TIMBER BATTER PILE

m PILE MISSING

NB PILE NOT BEARING AT CAP

PILE LENGTH BELOW MUDLINE

INSPECTION LEVEL DESIGNATIONS

LEVEL I all perimeter piles from bents 103 to 250

\- all piles in every fifth bent from 105 to 245

S SIGNIFICANTLY DAMAGED PILE

LEVEL III inspected piles indicated by,

100% REMAINING CROSS-SECTIONAL AREA

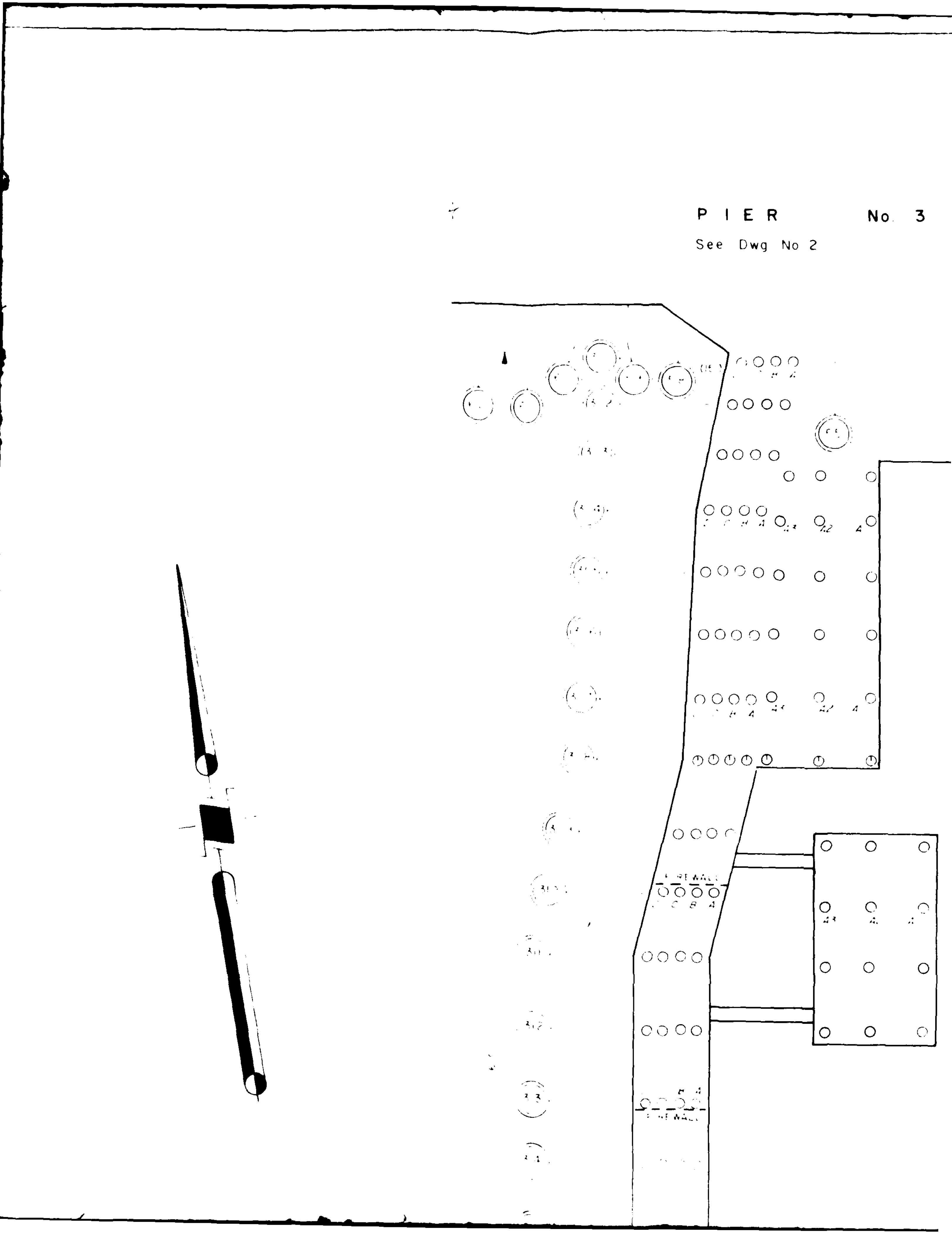
75% REMAINING CROSS-SECTIONAL AREA

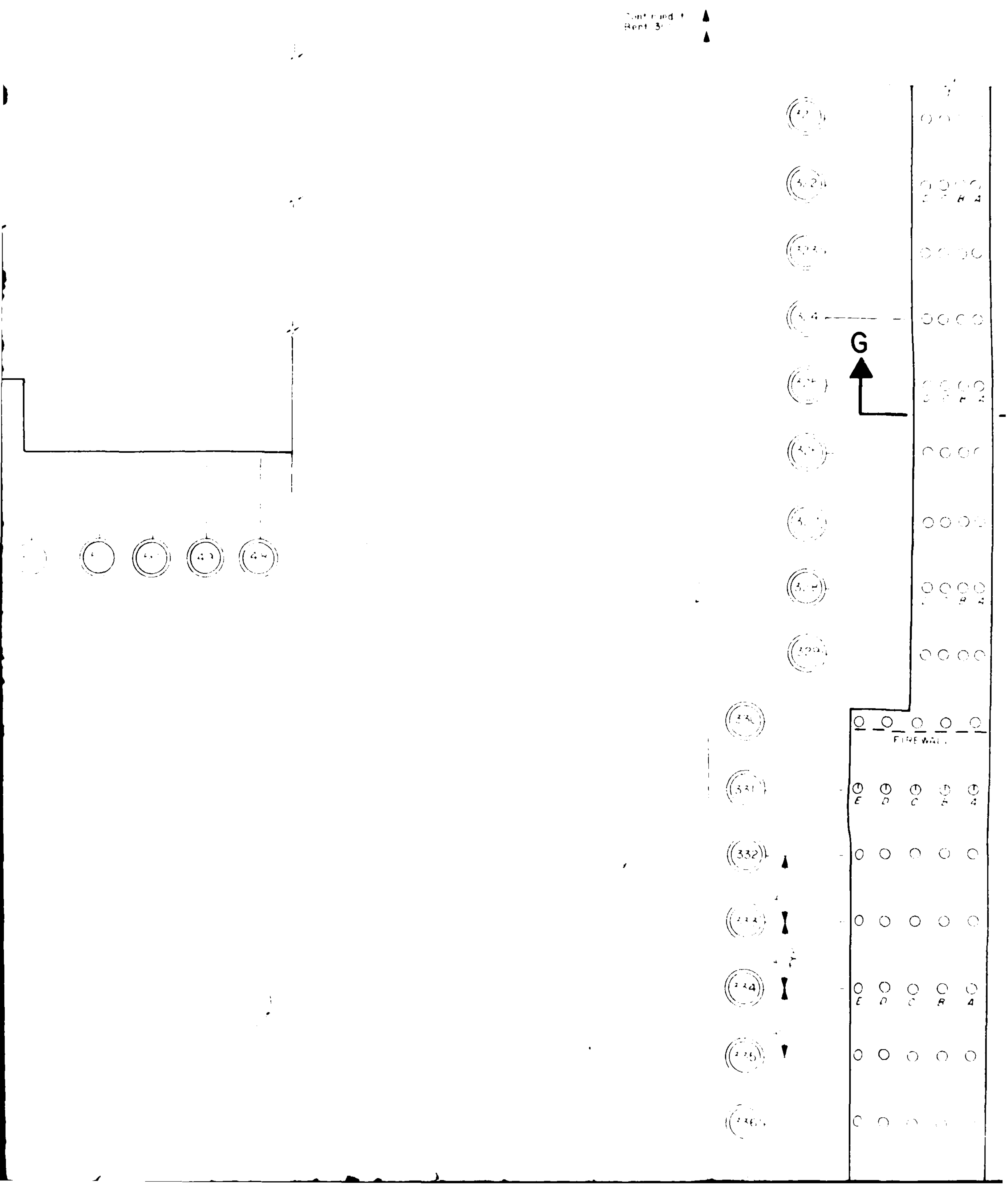
50% REMAINING CROSS-SECTIONAL AREA

25% REMAINING CROSS-SECTIONAL AREA

0 - 25% REMAINING CROSS-SECTIONAL AREA

J. AGI & ASSOCIATES CO. LTD. Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE DRAWN CHECKED J.P. APPROVED XIB DATE
PLAN SHOWING LOCATION AND CONDITION OF INSPECTED PILING IN PIER 3, APPROACHWAY TRESTLE U.S. NAVAL WEAPONS STATION CONCORD, CALIFORNIA CHES DIV NAV FAC ENG COM REPORT No FPO-1-83-(19) CONTRACT No N62477-81-C-0498 TASK 2 **DWG. No. 3**	PROJECT No 83-1/3-2-100


P I E R No. 3
See Dwg No 2


G
FIREWALL
332
E D C B A

G

LEGEND

(3?)	BENT No
D	PILE ROW DESIGNATION
○	TIMBER PILE
○——	TIMBER BATTER PILE
m	PILE MISSING
NB	PILE NOT BEARING AT CAP
(10)	PILE LENGTH, CURB TO MUDLINE

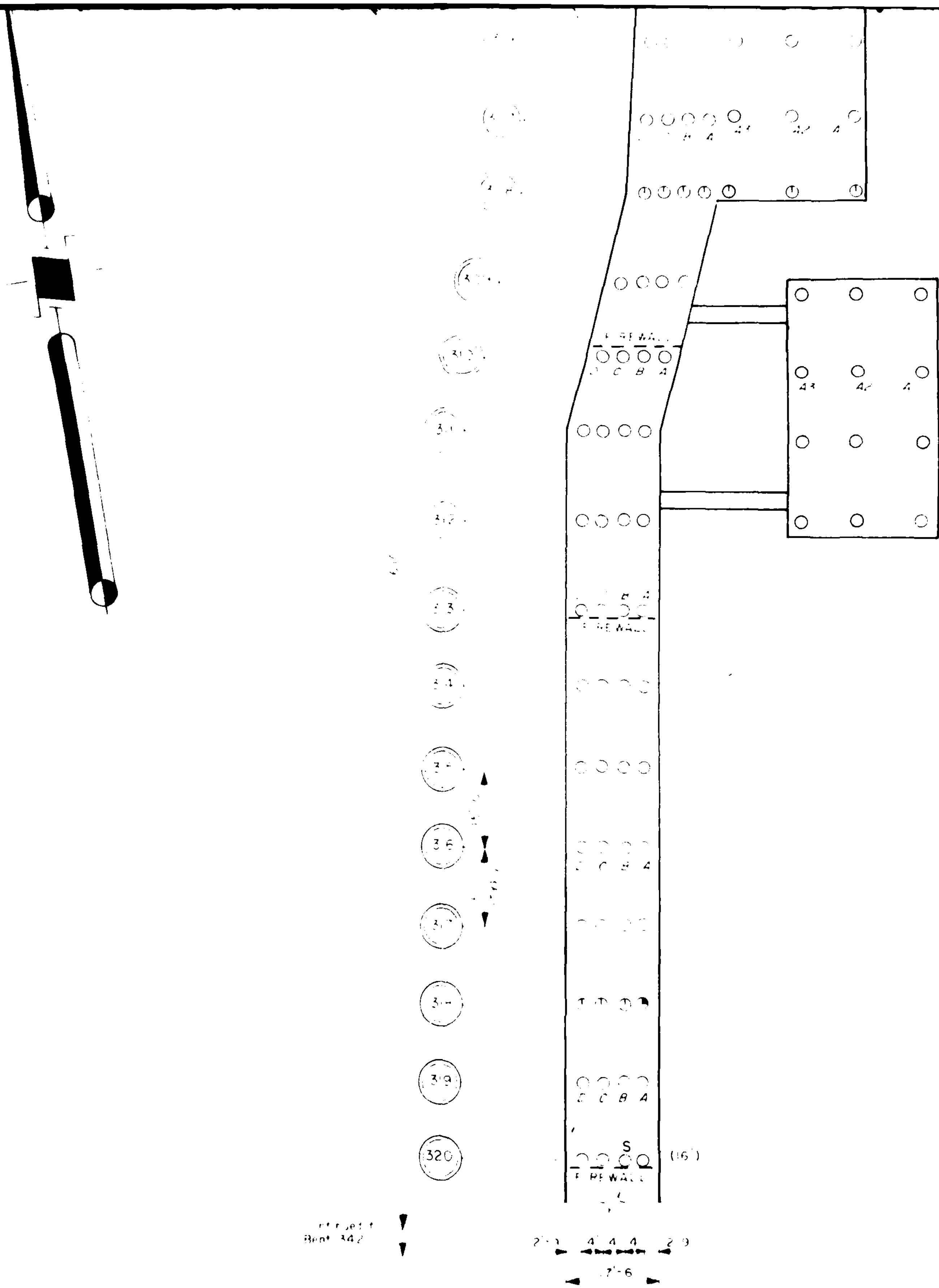
INSPECTION LEVEL DESIGNATIONS

LEVEL I - all perimeter piles from bents 301 to 335 on the west side and 303 to 335 on the east side
- all piles in bents 301, 305, 310, 315, 320, 325 and 330

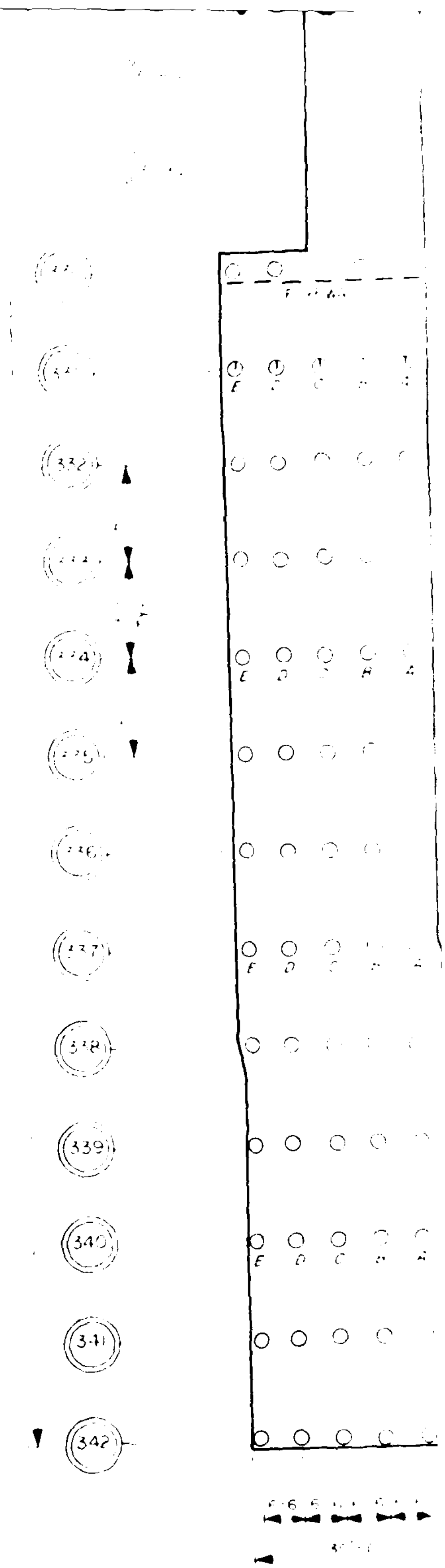
S SIGNIFICANTLY DAMAGED PILE

LEVEL II inspected piles indicated by,

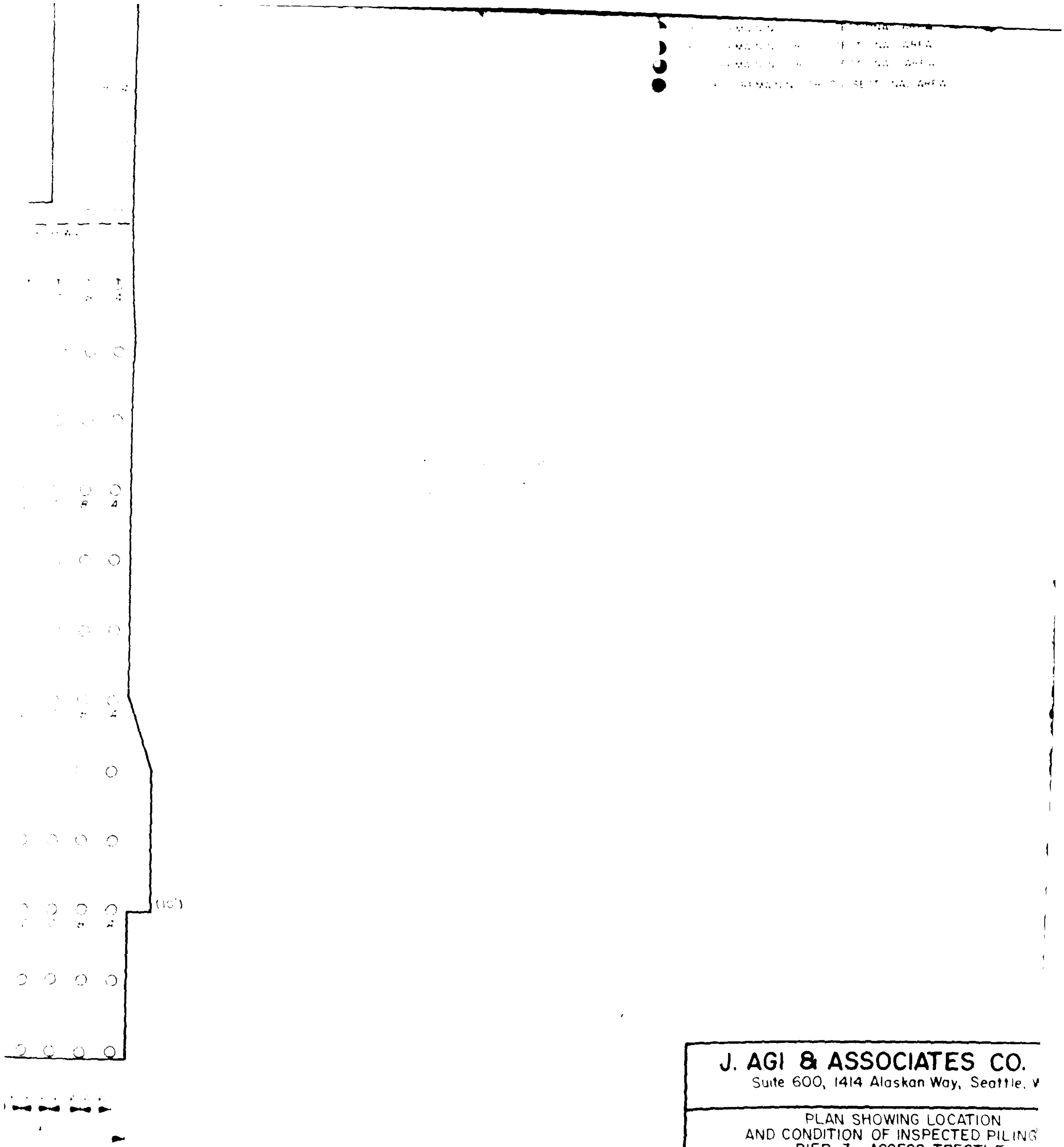
○ 100% REMAINING CROSS-SECTIONAL AREA
◔ 75% REMAINING CROSS-SECTIONAL AREA
◑ 50% REMAINING CROSS-SECTIONAL AREA
◕ 25% REMAINING CROSS-SECTIONAL AREA
● 0-25% REMAINING CROSS-SECTIONAL AREA



FIREWALL
C B A
A3 A2 A
320
S
(16')
Bent 342
27'-6



339
340
341
342



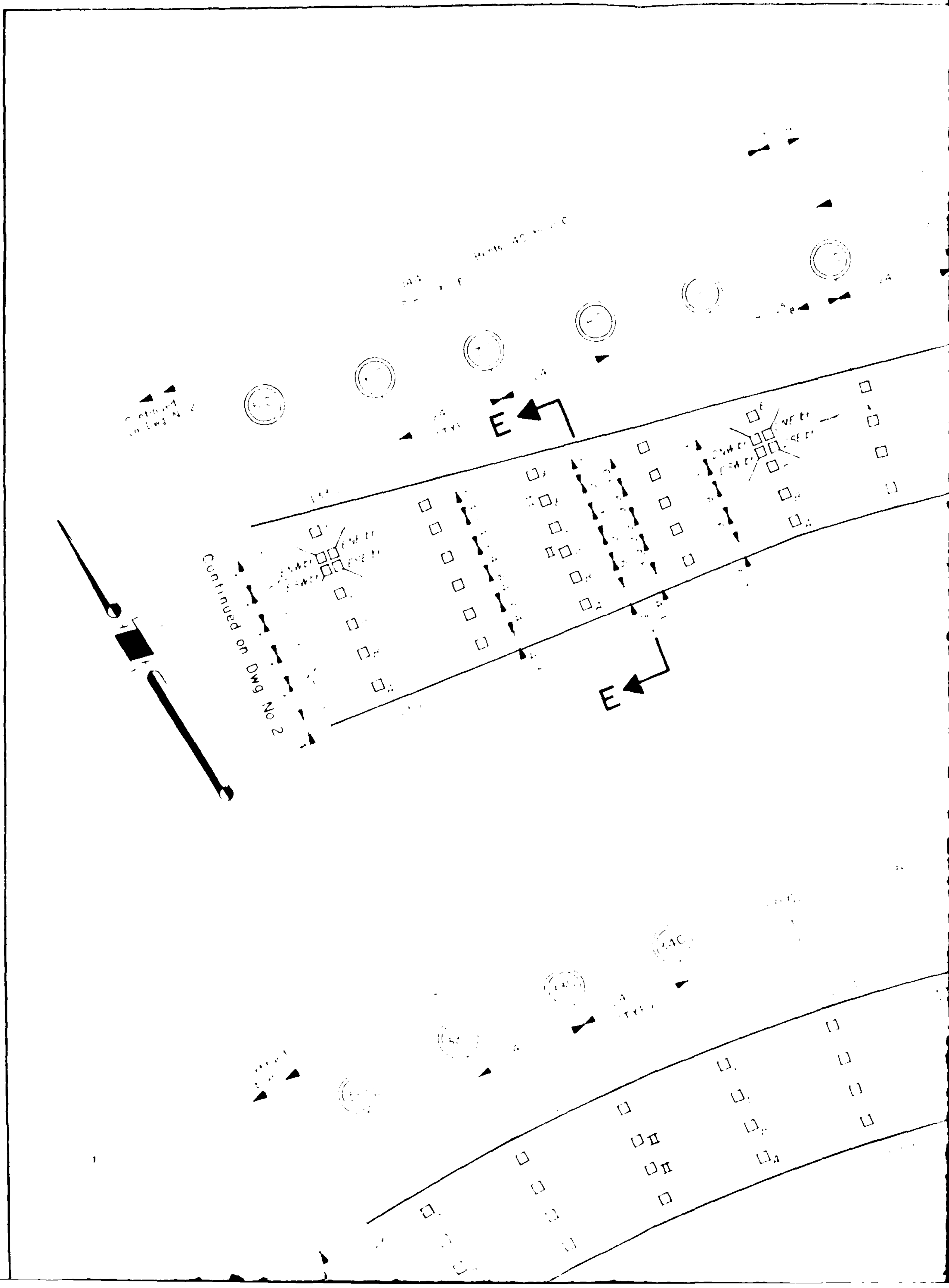
J. AGI & ASSOCIATES CO.
Suite 600, 1414 Alaskan Way, Seattle, W

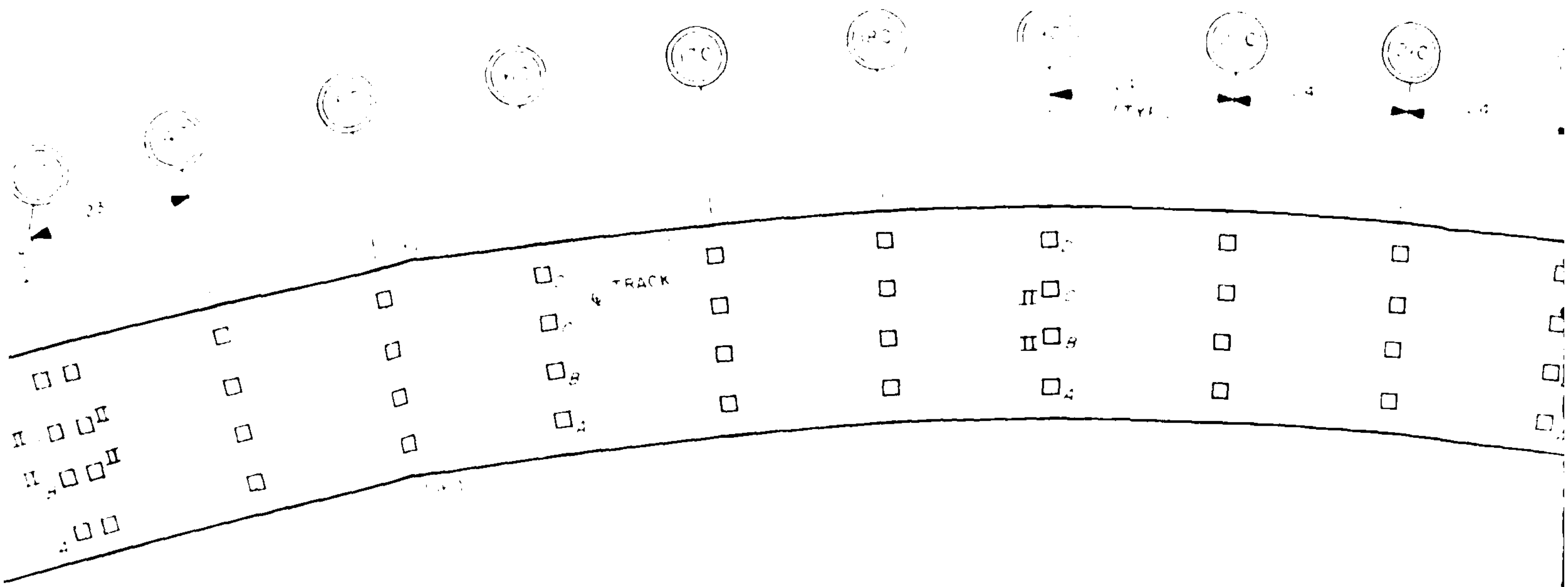
PLAN SHOWING LOCATION
AND CONDITION OF INSPECTED PILING
PIER 3, ACCESS TRESTLE
U.S. NAVAL WEAPONS STATION
CONCORD, CALIFORNIA

CHES DIV NAV FAC ENG COM
REPORT No. FPO-1-83-(19
CONTRACT No. N62477-81-C-04
TASK 2

DWG. No. 4

J. AGI & ASSOCIATES CO. LTD. Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE 1" = 20' DRAWN F.P. CHECKED J.I. APPROVED XIE DATE JUNE 6, 1983
PLAN SHOWING LOCATION AND CONDITION OF INSPECTED PILING IN PIER 3, ACCESS TRESTLE U S NAVAL WEAPONS STATION CONCORD, CALIFORNIA CHES DIV NAV FAC ENG COM REPORT No FPO-1-83-(19) CONTRACT No. N62477-81-C-0498 TASK 2 **DWG. No. 4**	PROJECT No 83-1/3-2-100


E
Continued on Dwg No 2
E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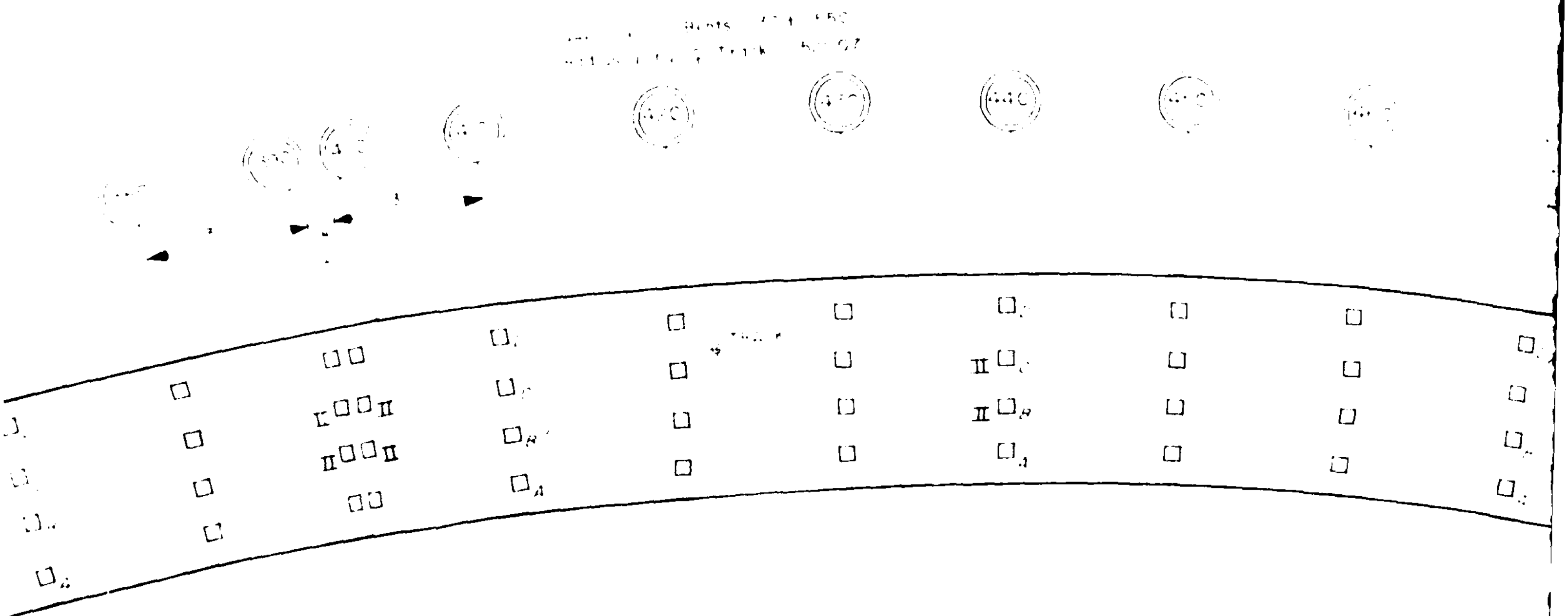
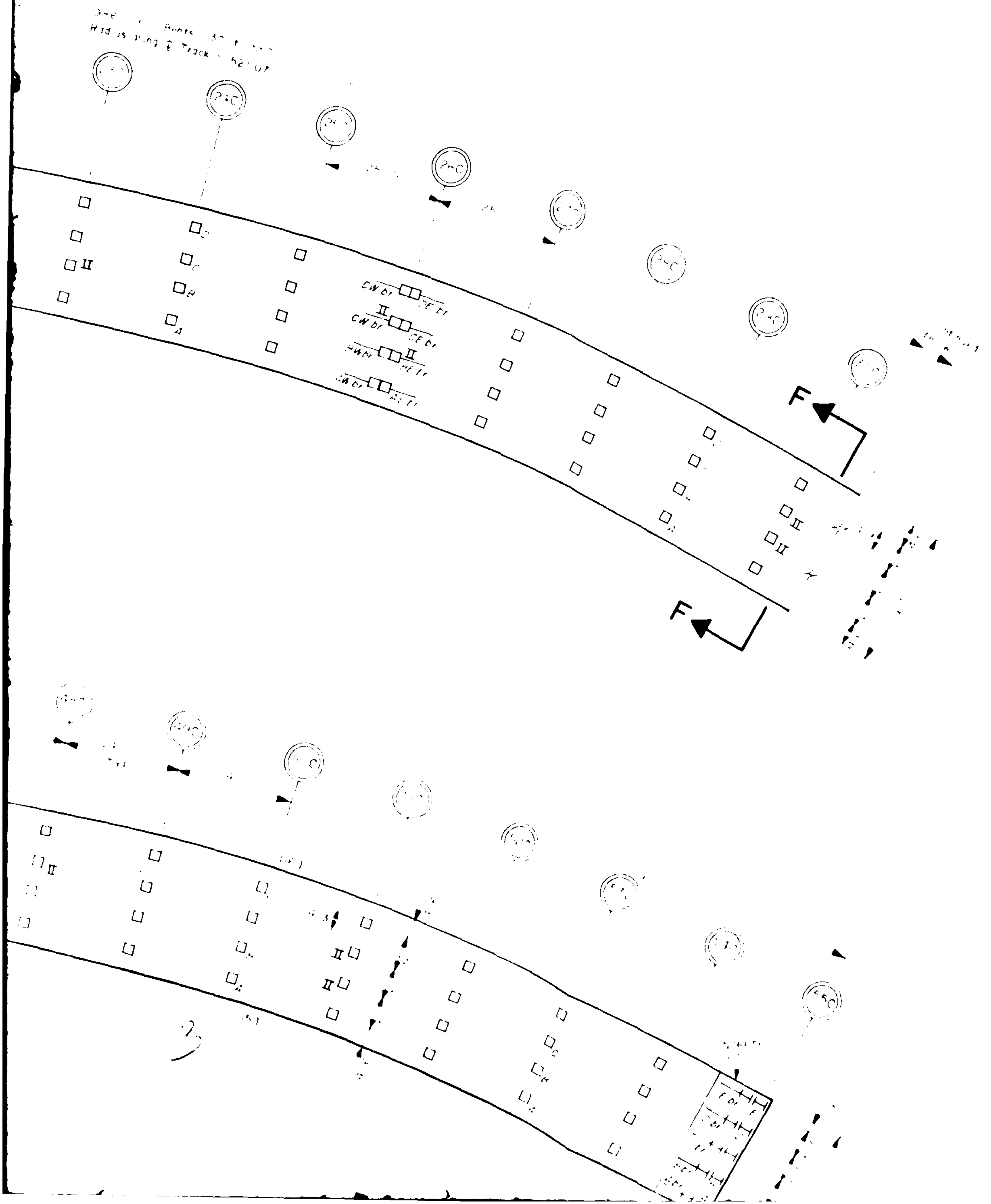
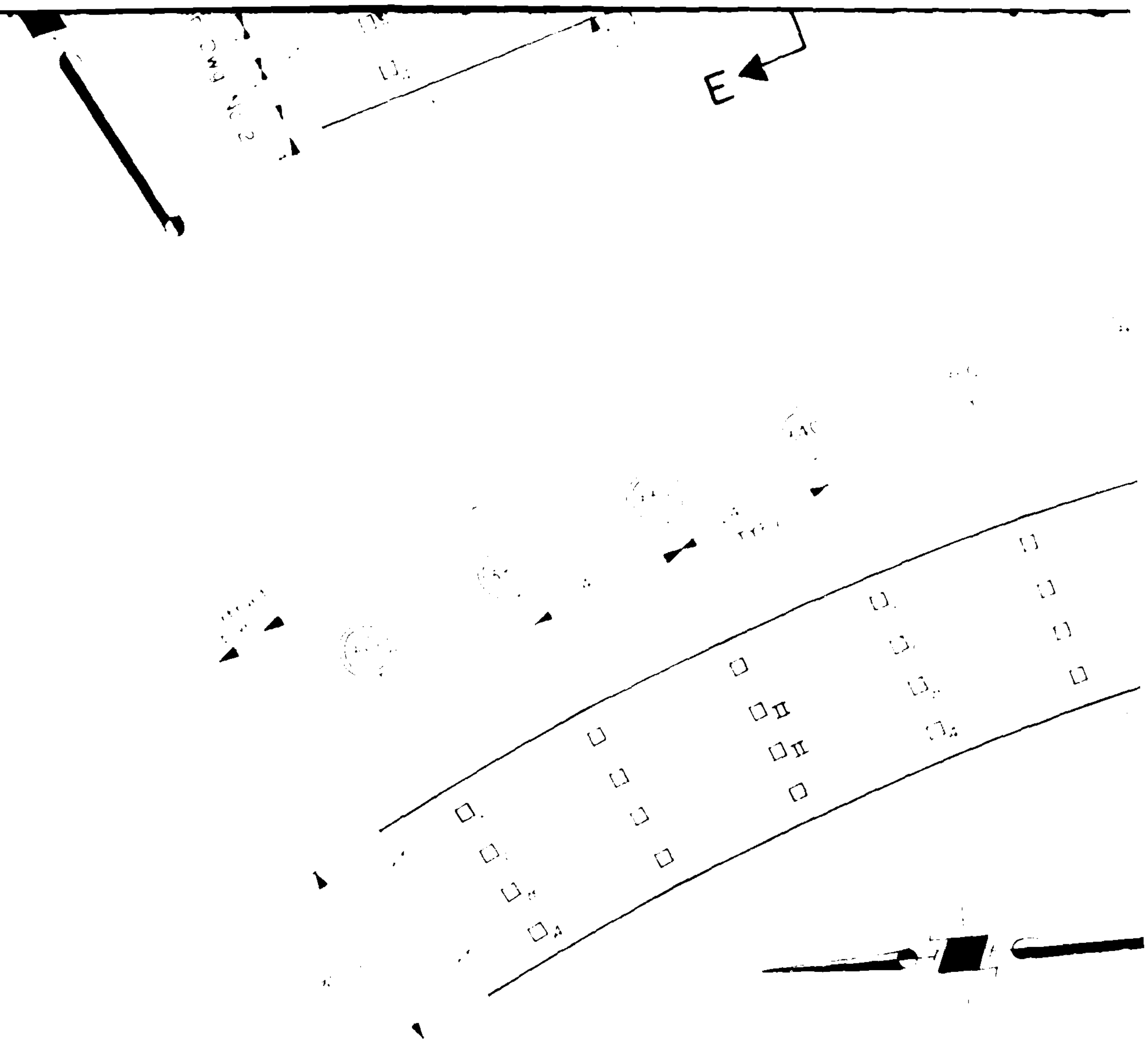



F
F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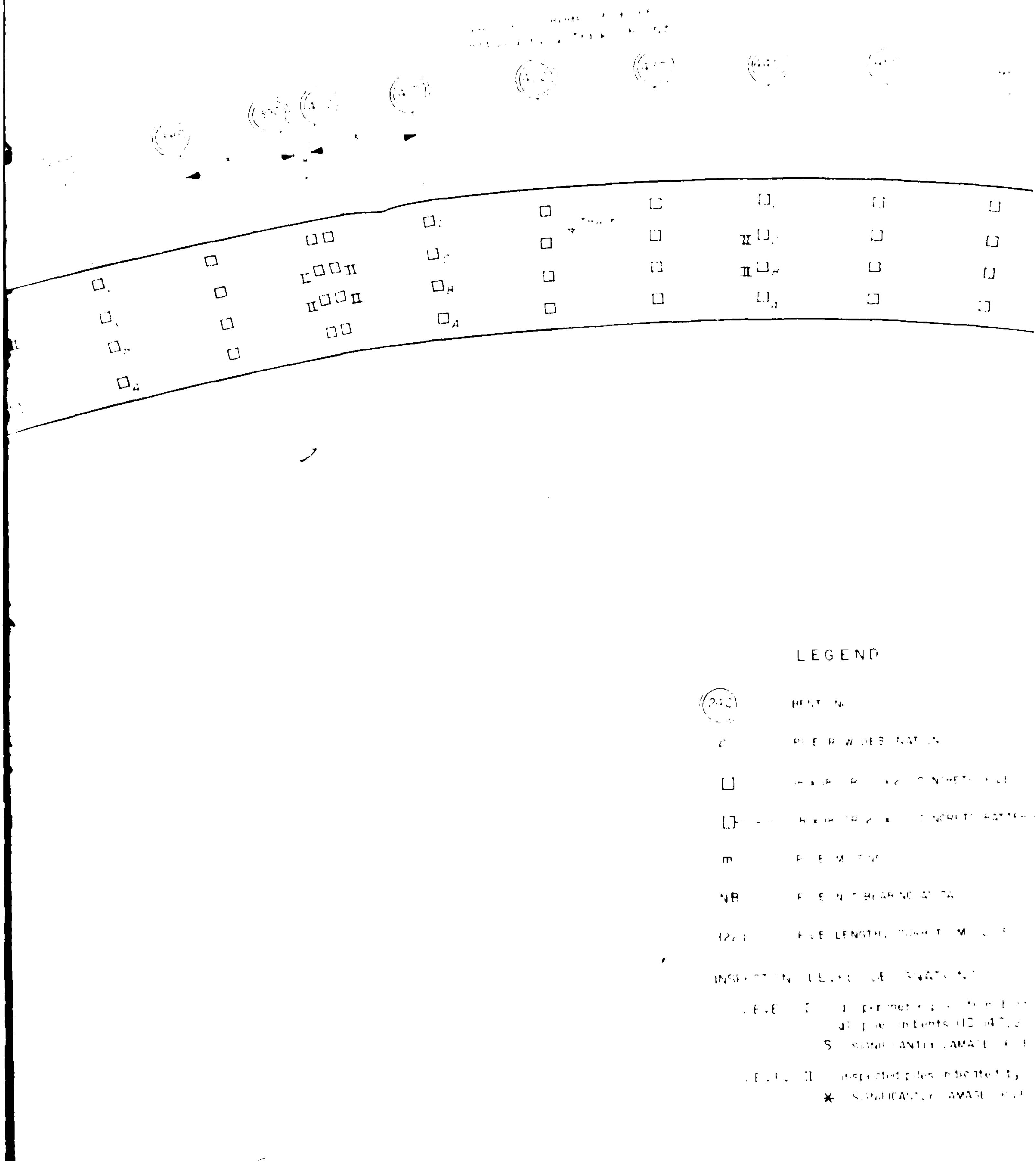

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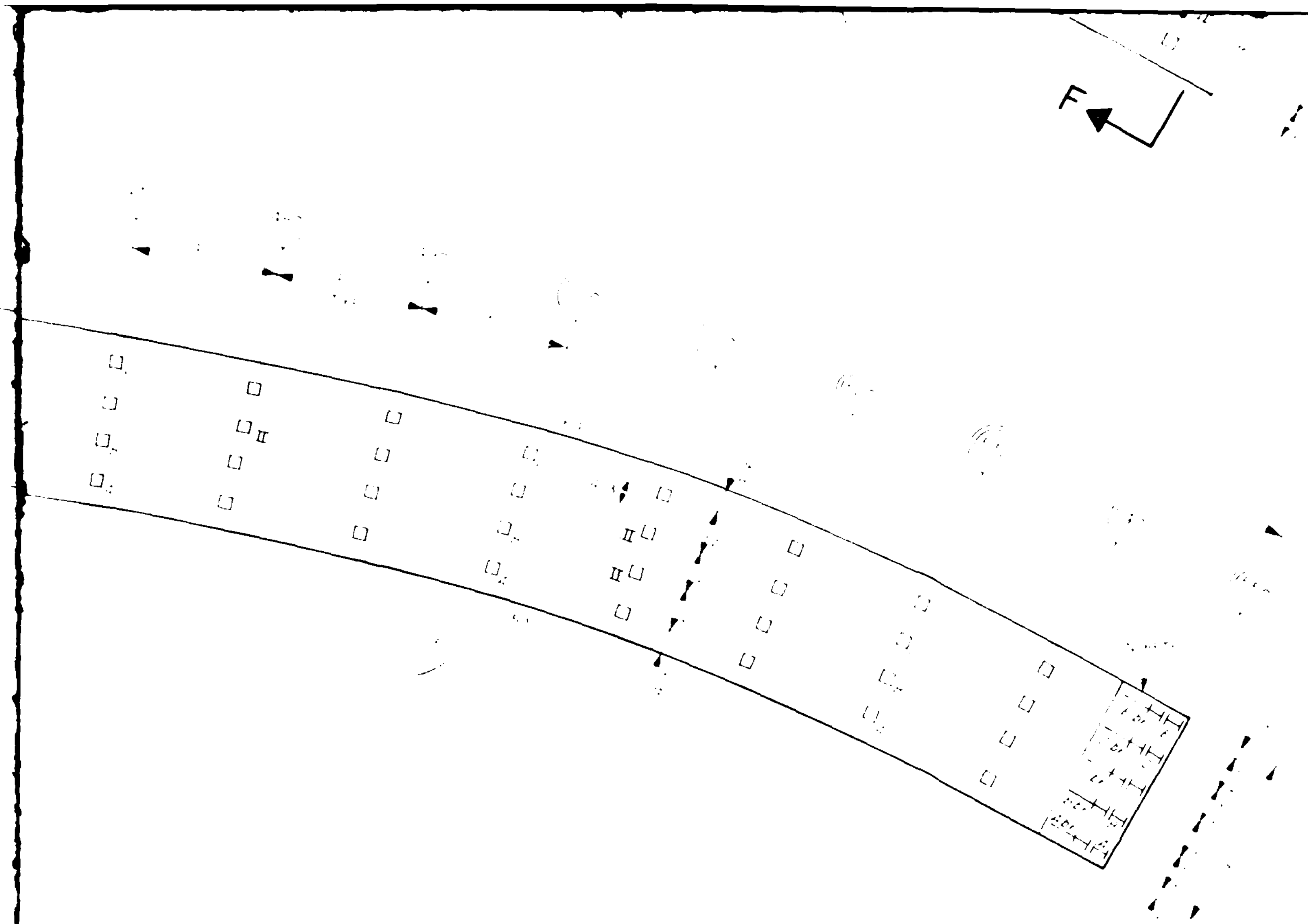
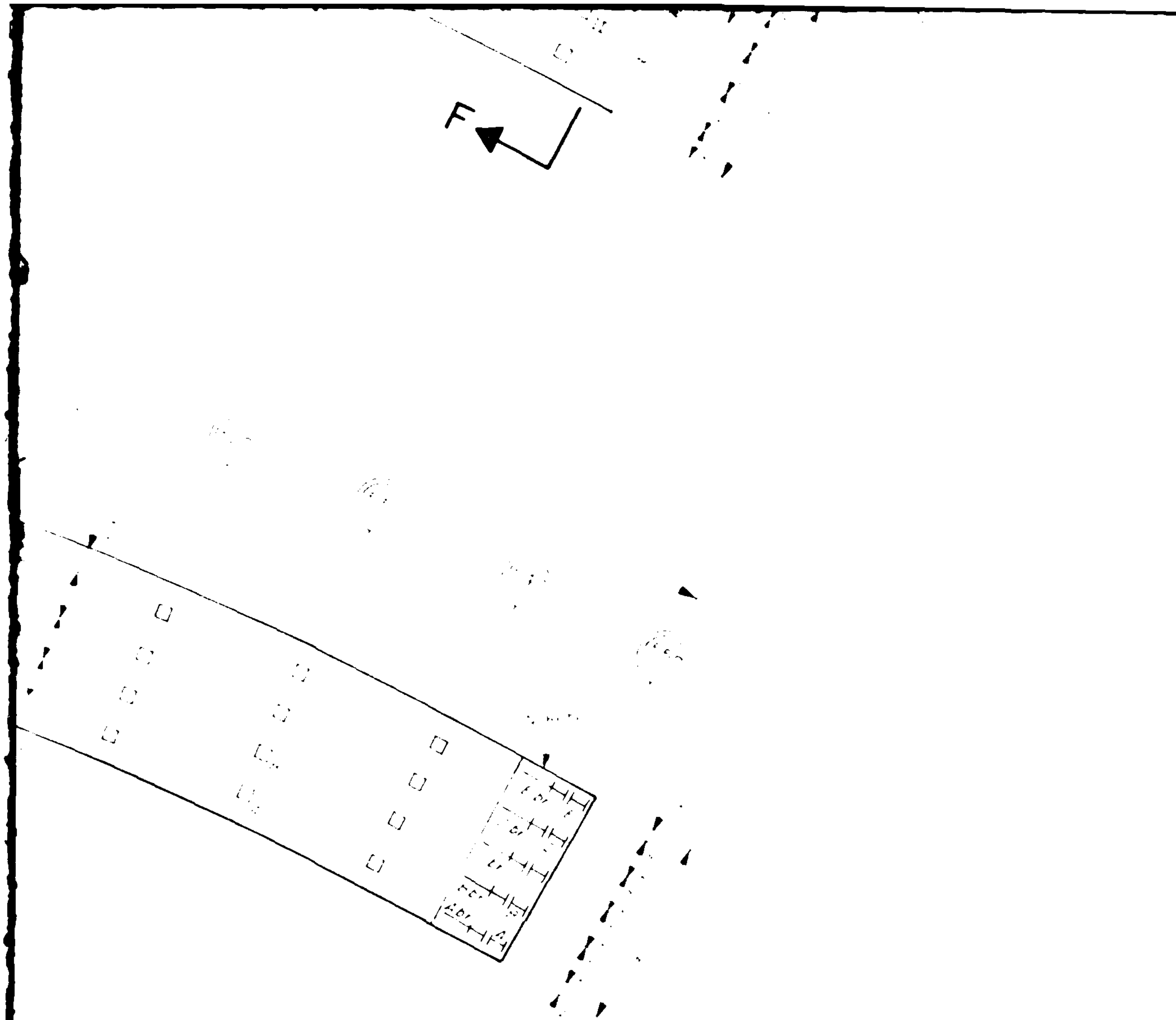


J. AGI & ASSOCIATES
Suite 600, 1414 Alaskan Way,

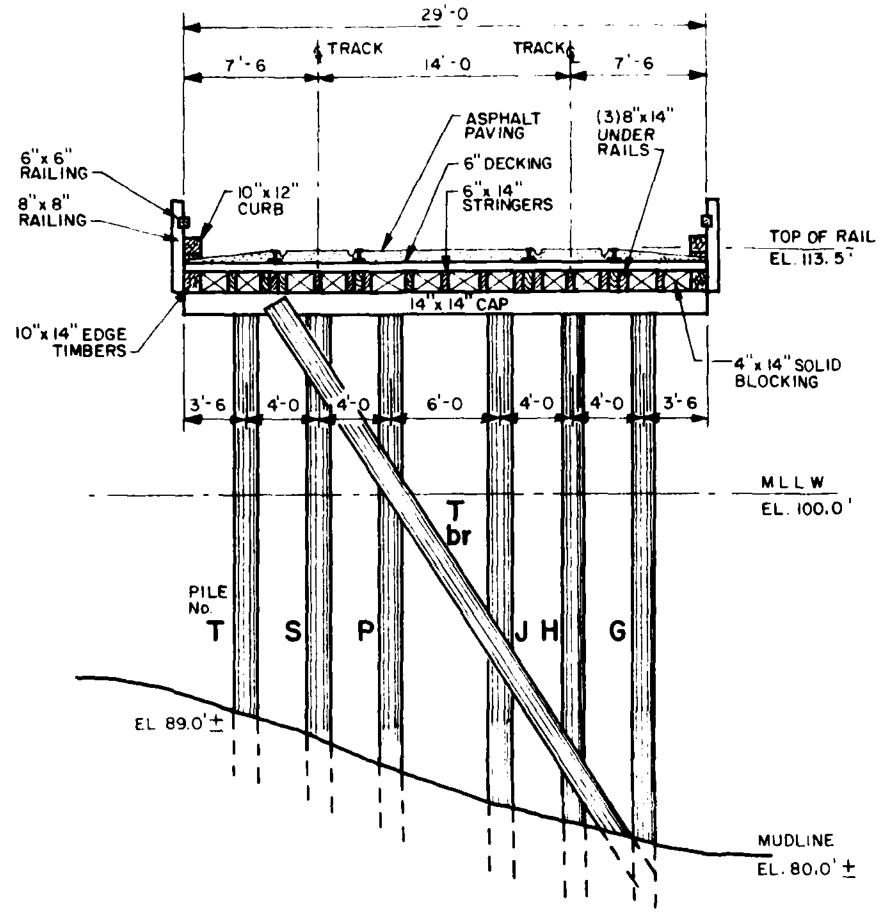
PLAN SHOWING LOCAT
AND CONDITION OF INSPECTED
PIER 3, CONCRETE TRES
U S NAVAL WEAPONS STA
CONCORD, CALIFORNI

CHES DIV NAV FAC ENG
REPORT No FPO-1-83
CONTRACT No N62477-81-
TASK 2

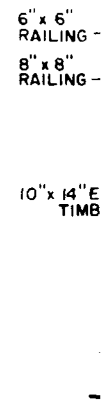
DWG. No. 5

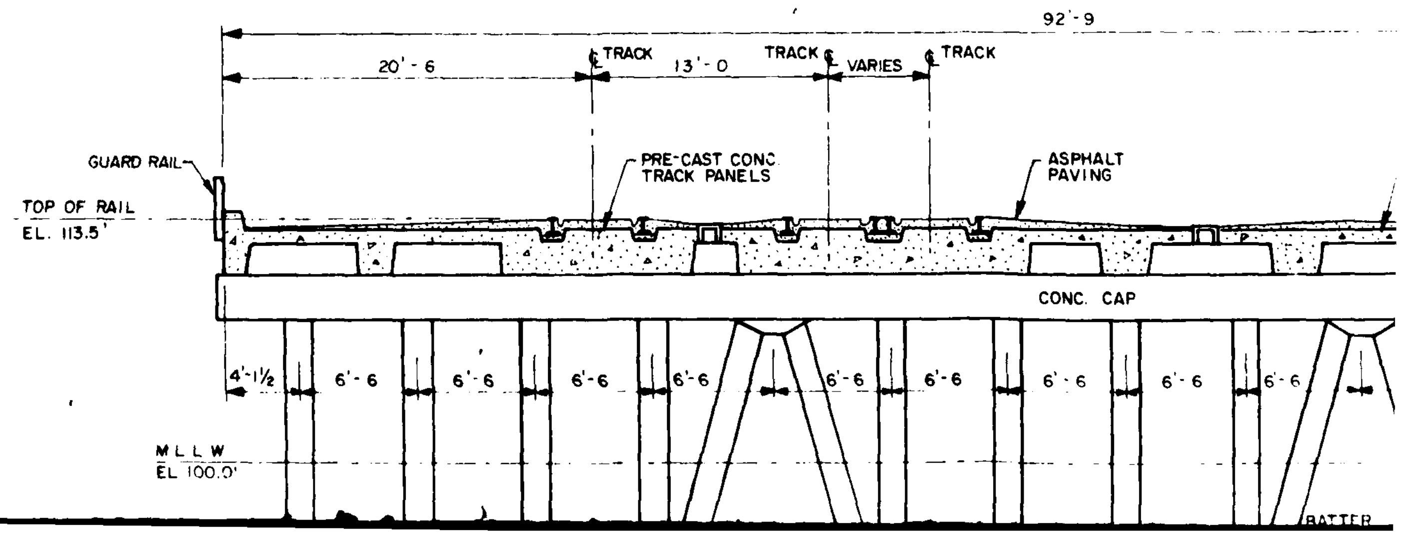


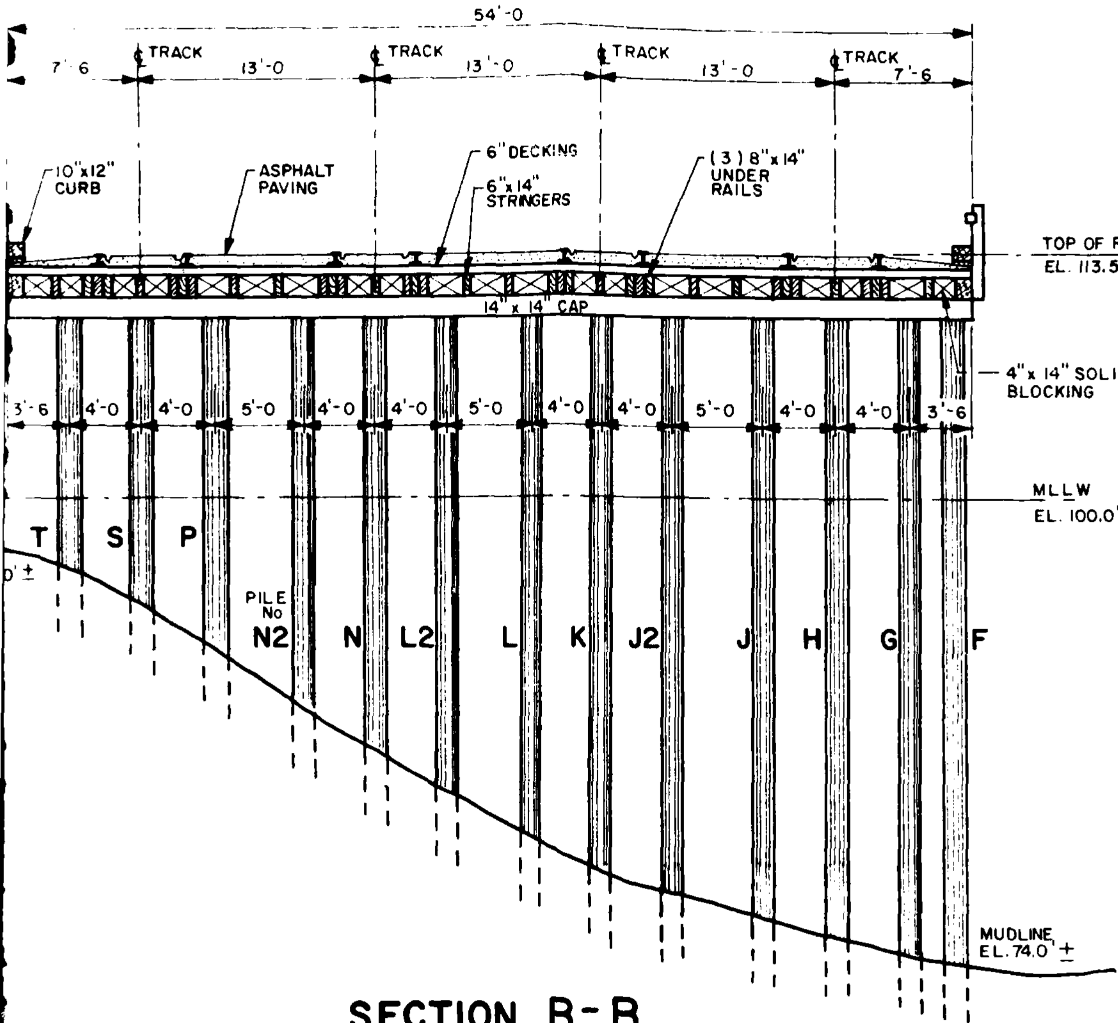
J. AGI & ASSOCIATES CO. LTD. Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE [illegible] 2[illegible] DRAWN F.F. CHECKED J.P. APPROVED XIB DATE JUNE [illegible]
PLAN SHOWING LOCATION AND CONDITION OF INSPECTED PILING IN PIER 3, CONCRETE TRESTLE U S NAVAL WEAPONS STATION CONCORD, CALIFORNIA CHES DIV NAV FAC ENG COM REPORT No FPO-1-83-(19) CONTRACT No N62477-81-C-0498 TASK 2 **DWG. No. 5**	PROJECT No **83-1/3-2-100**



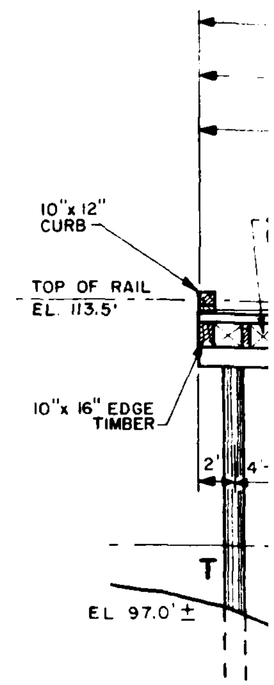
SECTION A-A
APPROACH TRESTLE
BENT 166

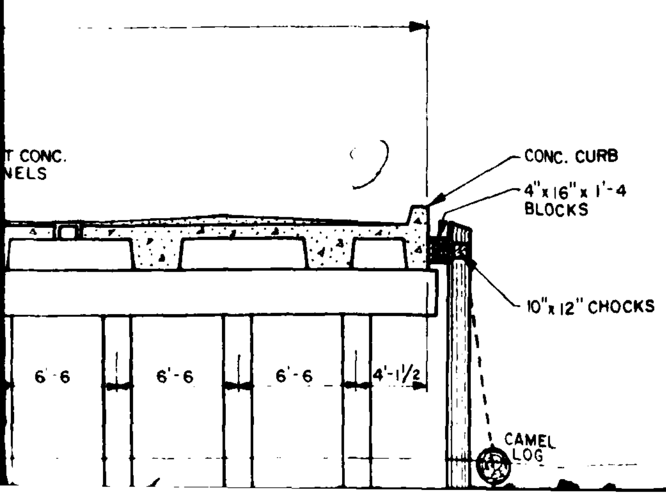


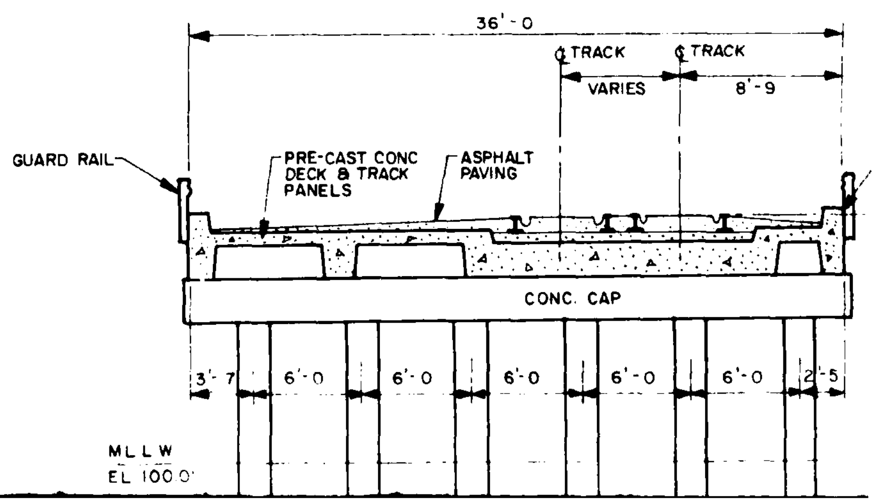


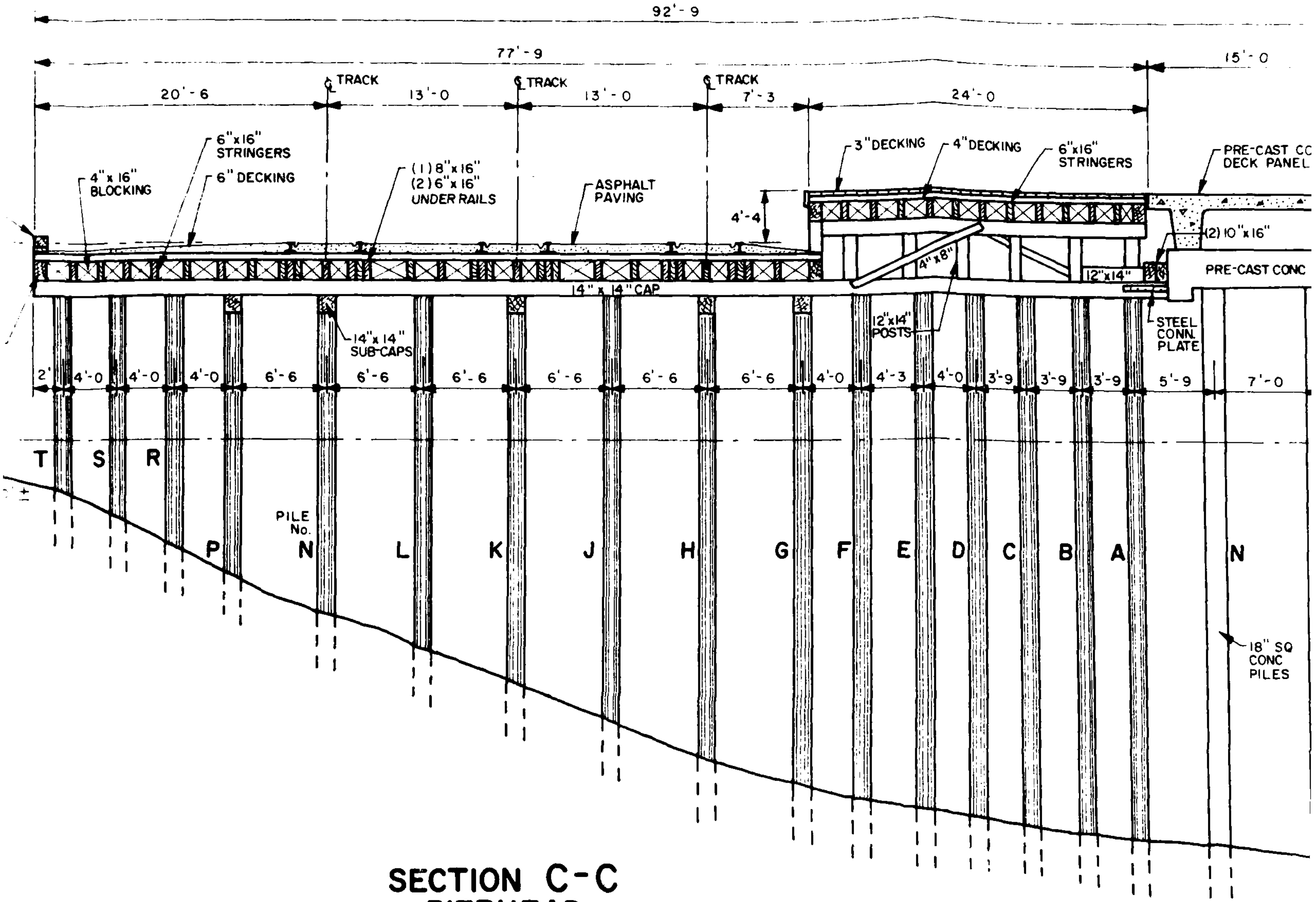


SECTION B-B
APPROACH TRESTLE
BENT 109

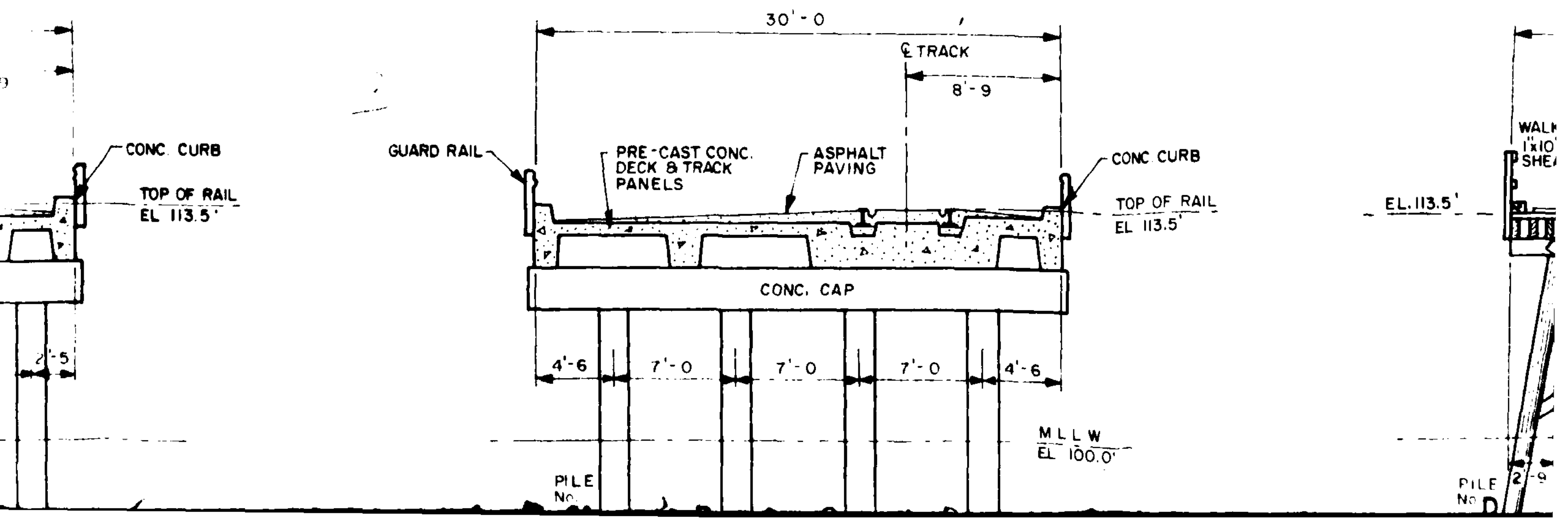


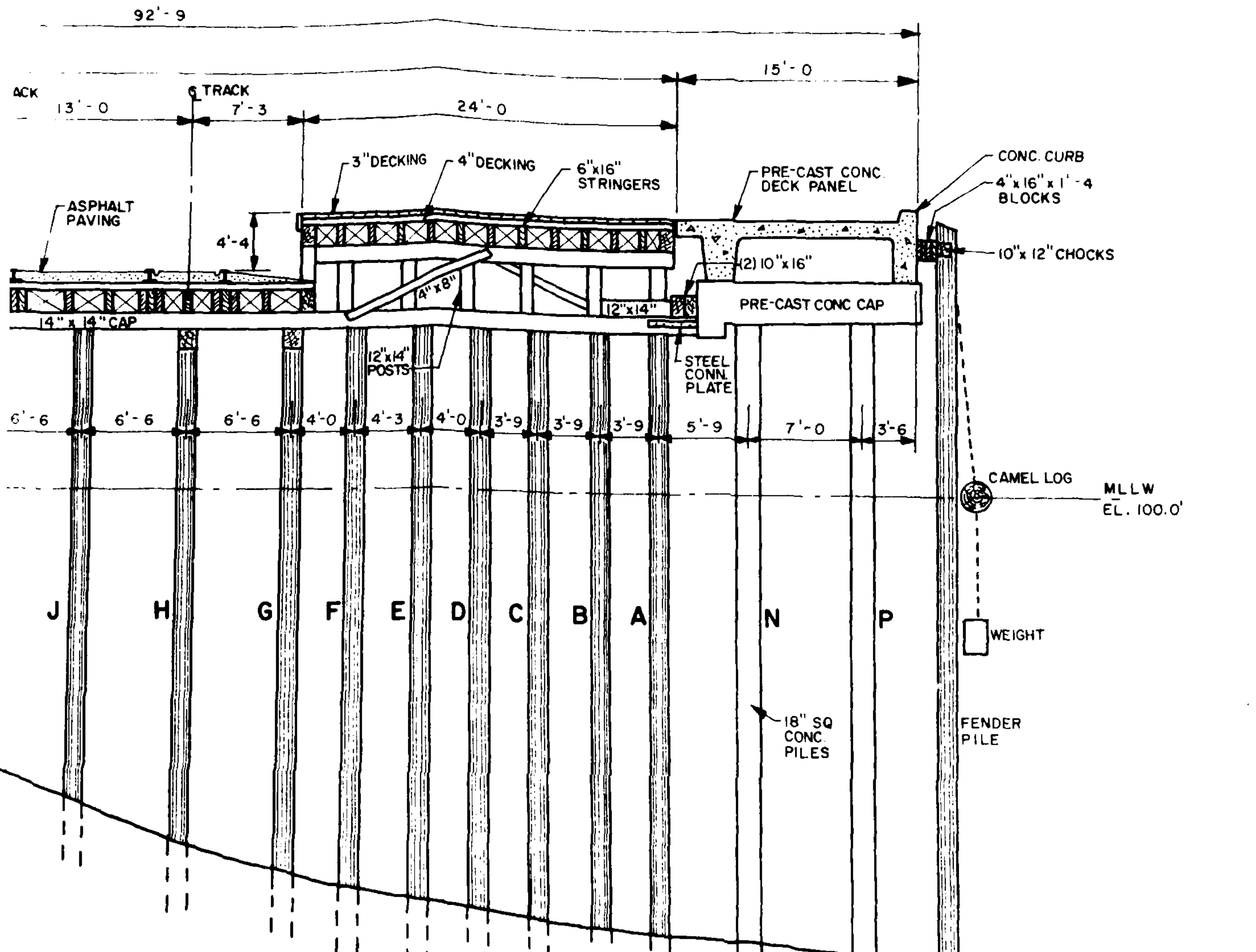




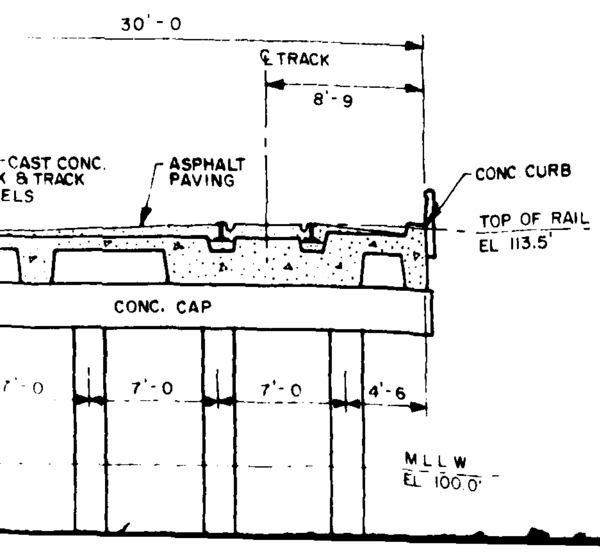


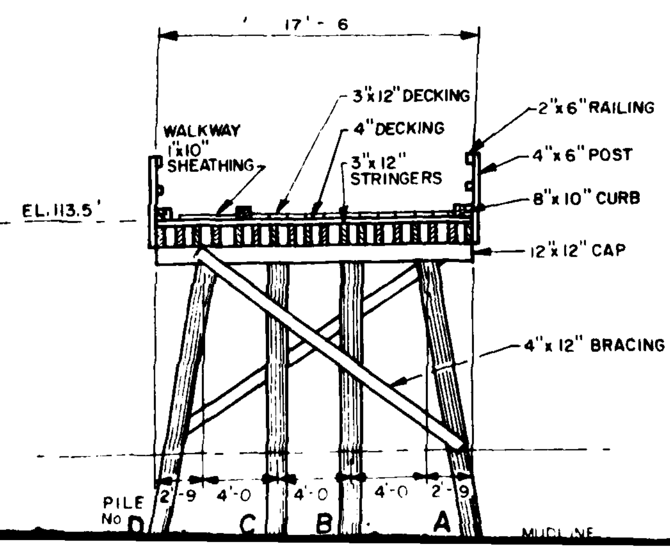
SECTION C-C
PIERHEAD
BENT 18

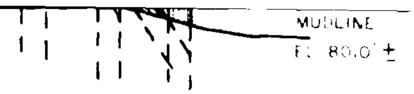



92'-9
15'-0
ACK
13'-0
℄ TRACK
7'-3
24'-0
3"DECKING
4"DECKING
6"x16" STRINGERS
PRE-CAST CONC. DECK PANEL
CONC. CURB
4"x16"x1'-4 BLOCKS
10"x12" CHOCKS
ASPHALT PAVING
4'-4
(2) 10"x16"
4"x8"
12"x14"
PRE-CAST CONC CAP
14"x14" CAP
12"x14" POSTS
STEEL CONN. PLATE
6'-6
6'-6
6'-6
4'-0
4'-3
4'-0
3'-9
3'-9
3'-9
5'-9
7'-0
3'-6
CAMEL LOG
MLLW
EL. 100.0'
J
H
G
F
E
D
C
B
A
N
P
WEIGHT
18" SQ CONC. PILES
FENDER PILE
MUDLINE
EL 71.0' ±

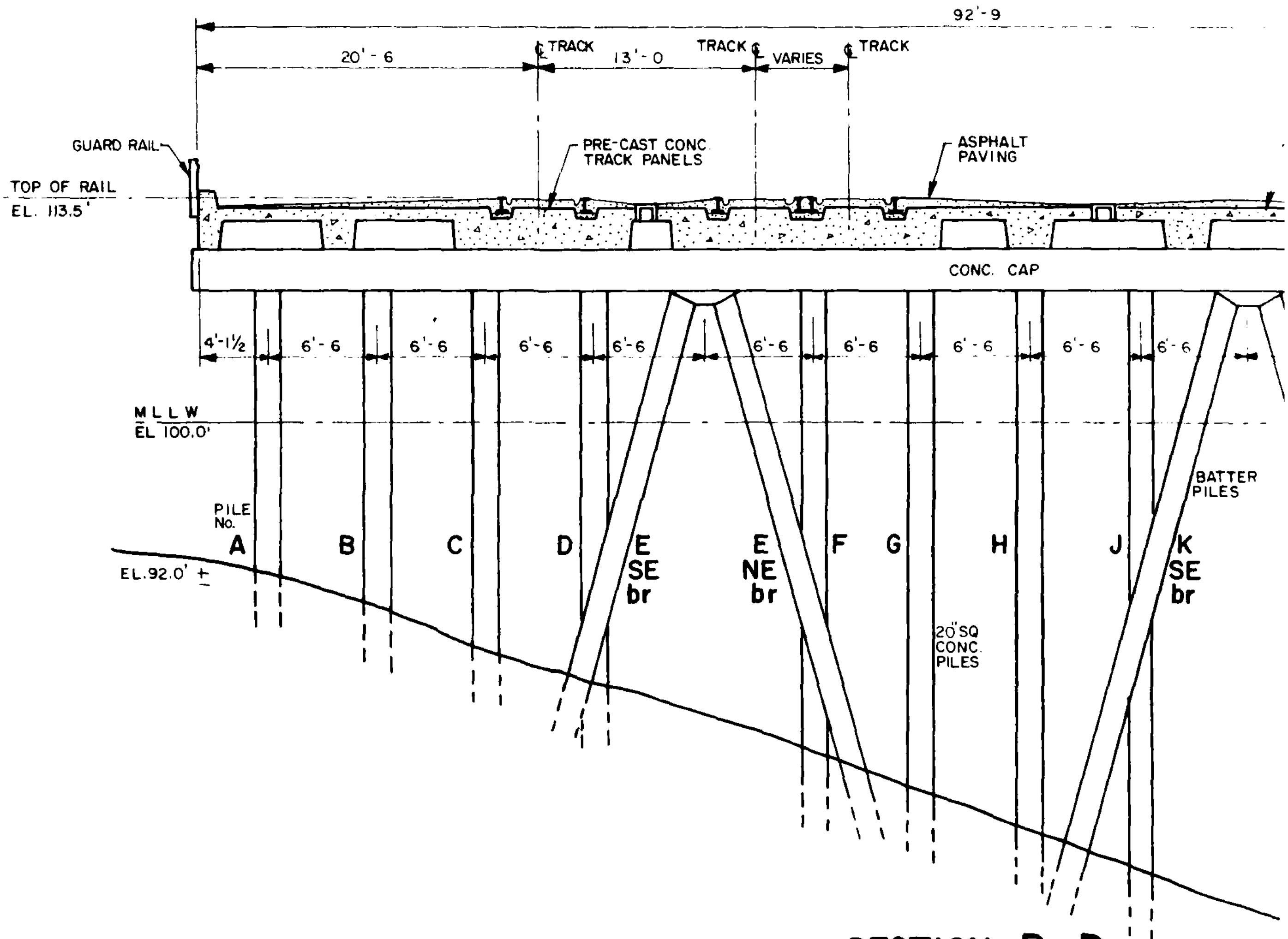
C-C
AD
18


30'-0
℄ TRACK
8'-9
-CAST CONC.
K & TRACK
ELS
ASPHALT PAVING
CONC CURB
TOP OF RAIL
EL 113.5'
CONC. CAP
7'-0
7'-0
7'-0
4'-6
MLLW
EL 100.0'

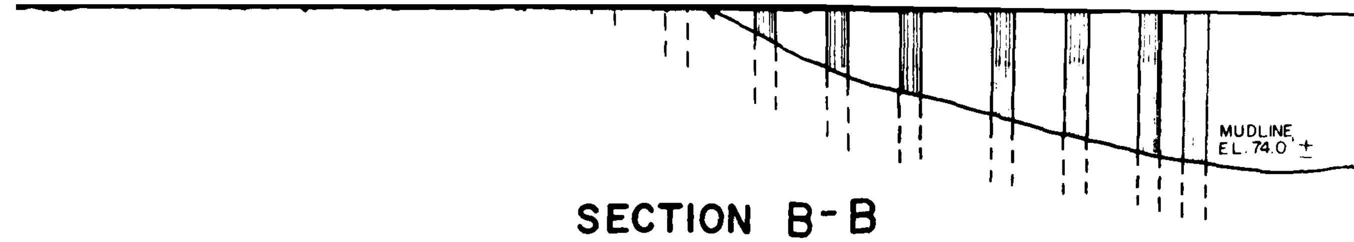

17'-6
3"x12" DECKING
4"DECKING
3"x12" STRINGERS
WALKWAY 1"x10" SHEATHING
2"x6" RAILING
4"x6" POST
8"x10" CURB
EL. 113.5'
12"x12" CAP
4"x12" BRACING
PILE No
D
C
B
A
2'-9
4'-0
4'-0
4'-0
2'-9
MUDLINE



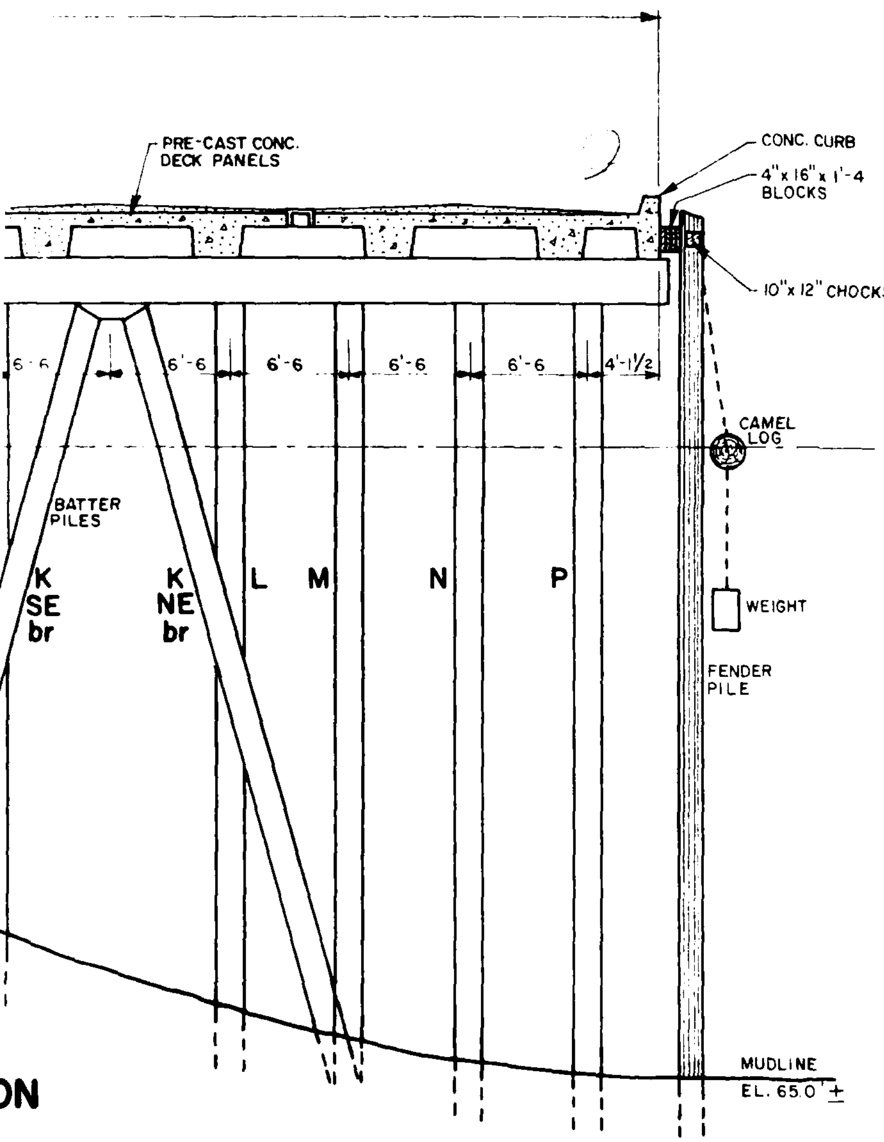
SECTION A-A
APPROACH TRESTLE
BENT 166



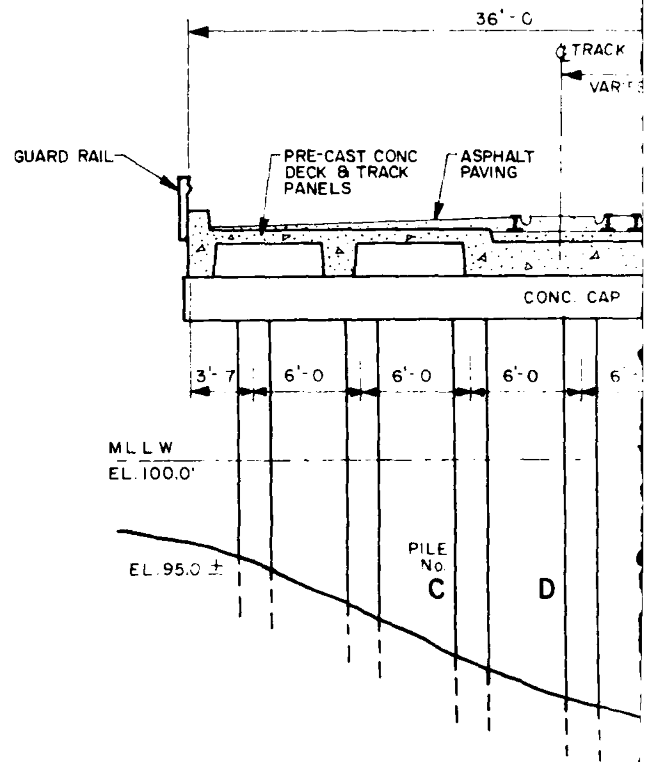
SECTION D-D
PIERHEAD
CONCRETE EXTENSION
BENT 3C



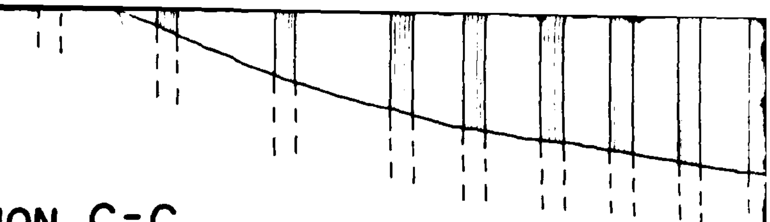
SECTION B-B
APPROACH TRESTLE
BENT 109



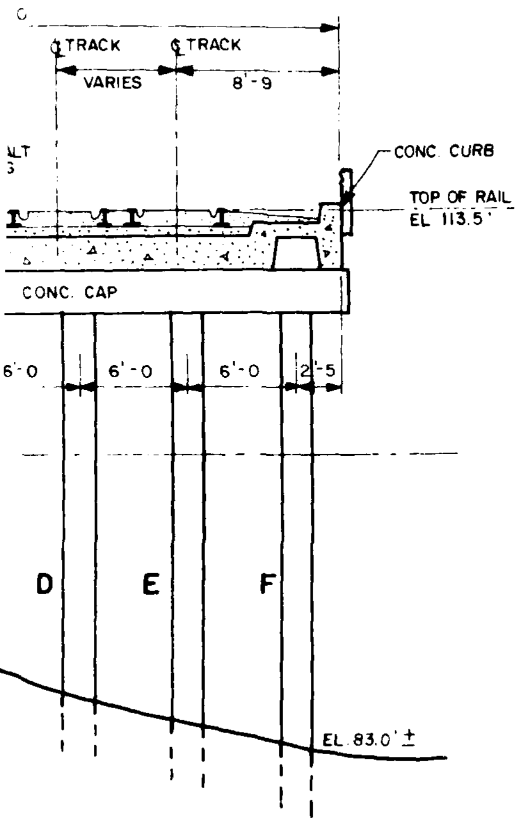
ON

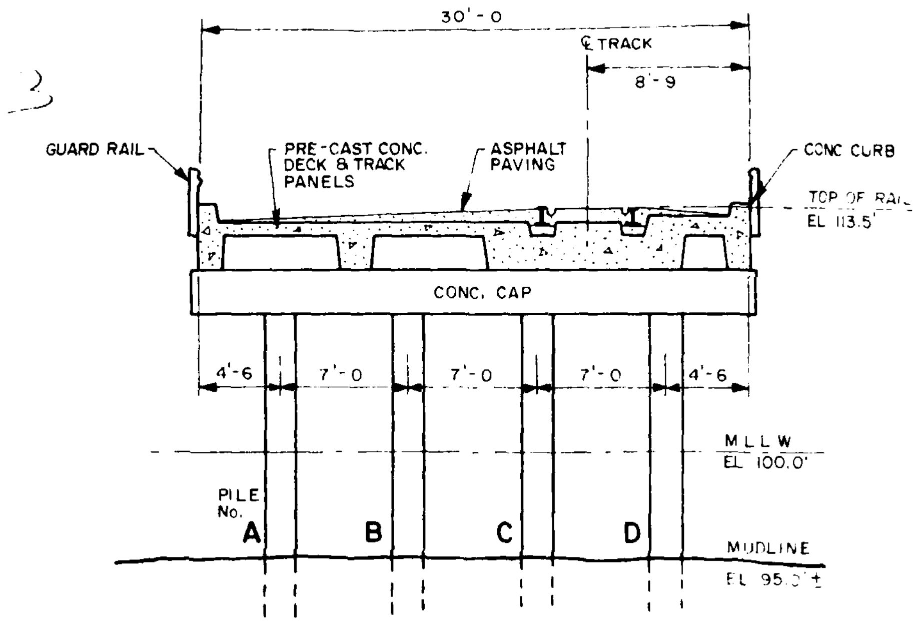


SECTION E-
CONCRETE TRE
BENT 7C



SECTION C-C
PIERHEAD
BENT 18





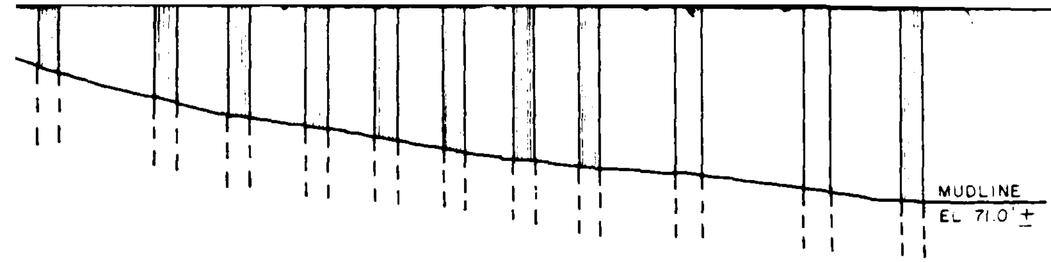
SECTION F-F
CONCRETE TRESTLE
BENT 30C

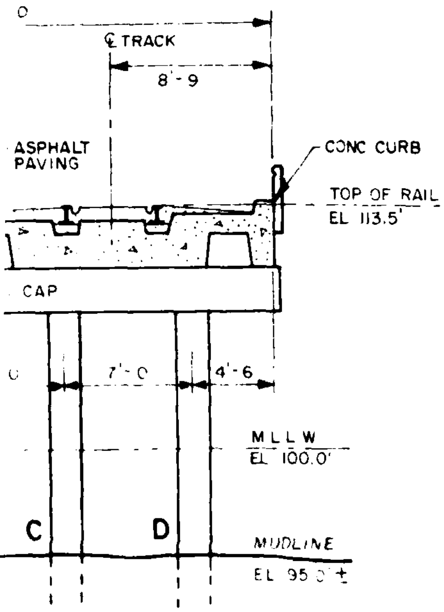
ON E-E
E TRESTLE
NT 7C

J. AGI &
Suite 6

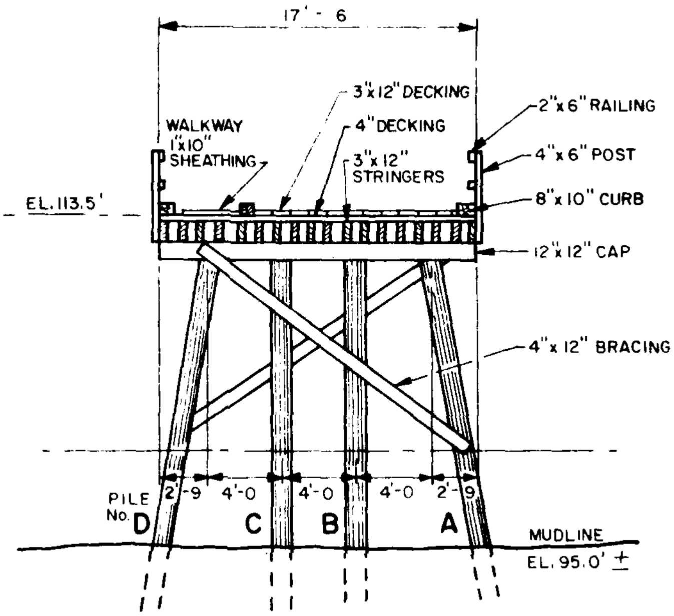
TY
U S

C
RE
CONT





N F-F
TRESTLE
T 30C



SECTION G-G
ACCESS TRESTLE
BENT 325

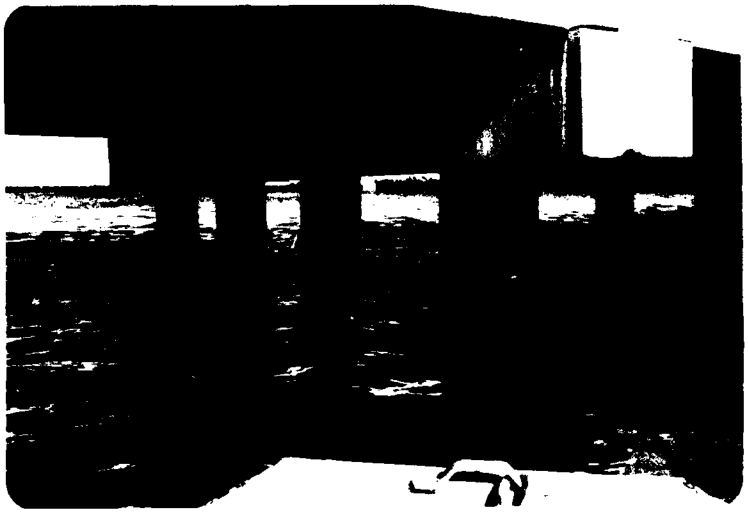
J. AGI & ASSOCIATES CO. LTD. Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE	1/8" = 1'-0
PLAN SHOWING TYPICAL SECTIONS THROUGH PIER 3 U.S. NAVAL WEAPONS STATION CONCORD, CALIFORNIA CHES DIV NAV FAC ENG COM REPORT No FPO-1-83-(19) CONTRACT No. N62477-81-C-0498 TASK 2 **DWG. No. 6**	DRAWN	F P
	CHECKED	F.P.
	APPROVED	X/E
	DATE	JUNE 6, 1983.
	PROJECT No	83-1/3-2-100

PHOTOGRAPH No. 6

Typical section at expanded pierhead showing original north face of timber pierhead and concrete extension. Note excellent condition of splash zones.

PHOTOGRAPH No. 7

Typical construction in Access Trestle. Note good condition of upper intertidal and splash zones.



PHOTOGRAPH No. 8

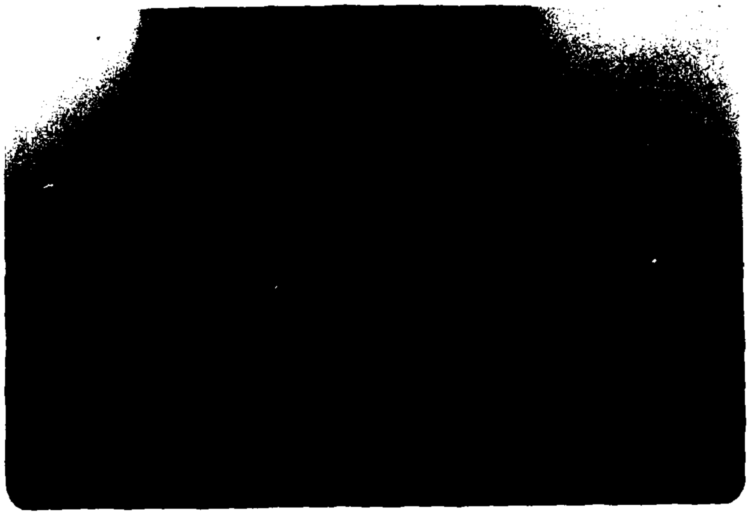
Concrete Trestle. Note typical construction and excellent condition of members in splash zone.

4.1.2 Observed Inspected Condition

The overall condition of Pier 3 is very good. As shown in Photographs 9 and 10 and detailed in Tables 2 and 3, the majority of the timber piles are in excellent condition. The Level I inspection covered a total of 974 timber piles. Of the 974 piles inspected, 936 (96%) are undamaged; 30 (3%) piles have sustained marine borer attack or mechanical damage. At this time, the damage is of a minor or cosmetic nature and does not detract from the structural integrity of the piles. A total of 8 (1%) piles were found to have significant damage. Photographs 11 - 15 identify and illustrate several of the damaged piles found. As shown in these photographs, the damage has been caused by mechanical impact or abrasion, marine borer infestation and by fungal decay. The damaged piles were found throughout the structure and the damage on the individual piles was found to range from the pile top through the splash zone to the intertidal zone.

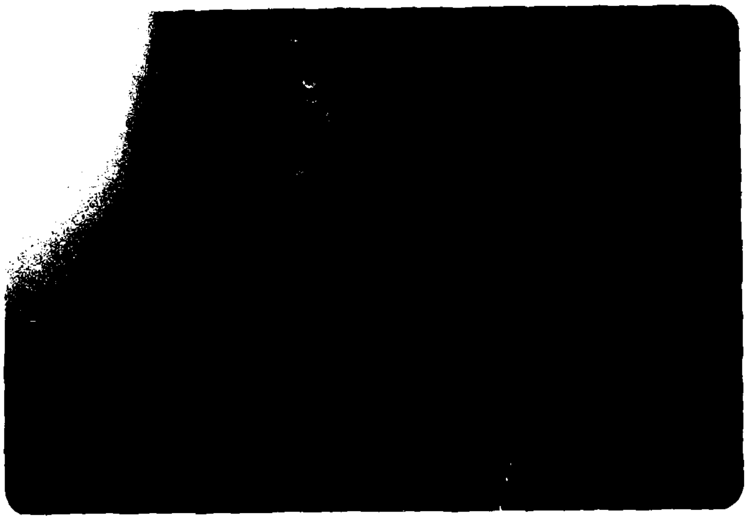
A total of 393 piles were subjected to detailed Level III ultrasonic testing and inspection. Of the 393 piles tested, 385 (98%) are undamaged and are in excellent condition; 6 (1.5%) piles have sustained minor marine borer attack or mechanical damage and are rated at 90 - 100% of their original cross-sectional area; and 2 (0.5%) of the piles have sustained moderate damage and are rated at 75 - 100%.

The condition of the concrete piles was also found to be very good. Photographs 16 and 17 serve to illustrate the condition of these piles in both intertidal and mudline zones. In the Level I inspection, a total of 200 piles were inspected. No significant damage was found on any pile, however, two piles were found to have minor or cosmetic spalling. The Level II inspection covered a total of 50 piles. As detailed in Table 1, these piles are in excellent condition; no significant damage was found.



PHOTOGRAPH No. 9

Timber pile with dense marine fouling; note no evidence of marine borer or mechanical damage.



PHOTOGRAPH No. 10

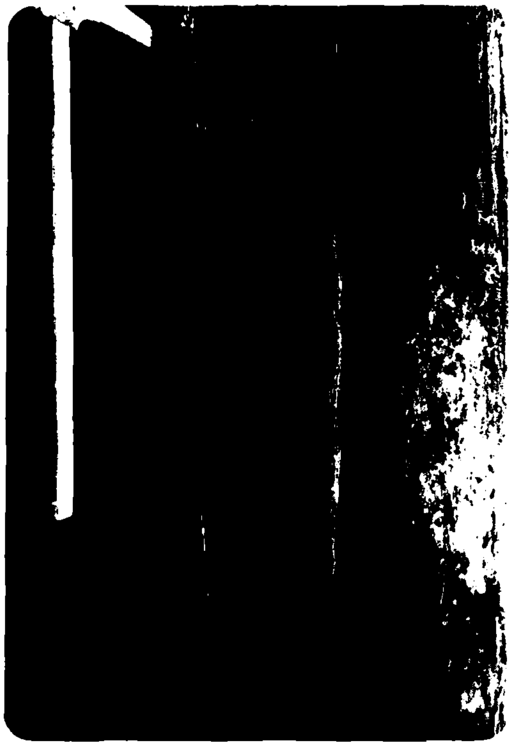
Undamaged timber pile with fouling organisms partially removed to expose pile surface. Also note density and thickness of fouling organisms.

PHOTOGRAPH No. 11

Bent 42 - piles A and A-Br. Note extensive loss of cross-section due to mechanical abrasion from the trapped drift log.

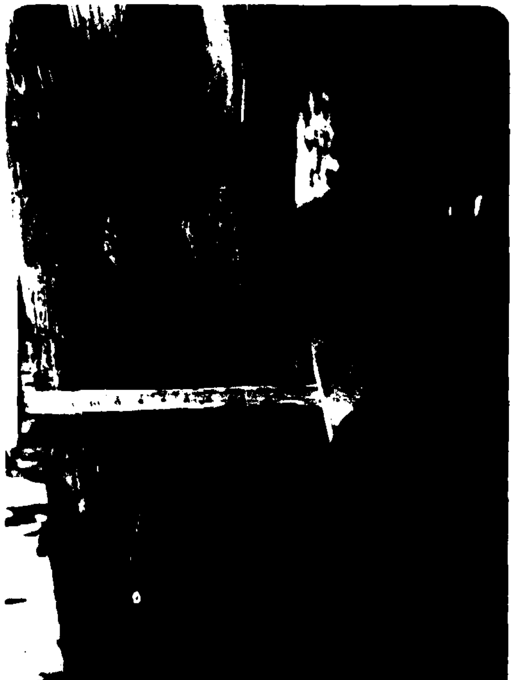
PHOTOGRAPH No. 12

Bent 149 - G-Br. Note extensive section loss due to teredine damage in the mid intertidal zone.



PHOTOGRAPH No. 13

Bent 14 - pile TN. Approximately 50% section loss in splash zone and mid intertidal zone due to fungal and/or marine borer damage. Note new pile TS adjacent to it.



PHOTOGRAPH No. 14

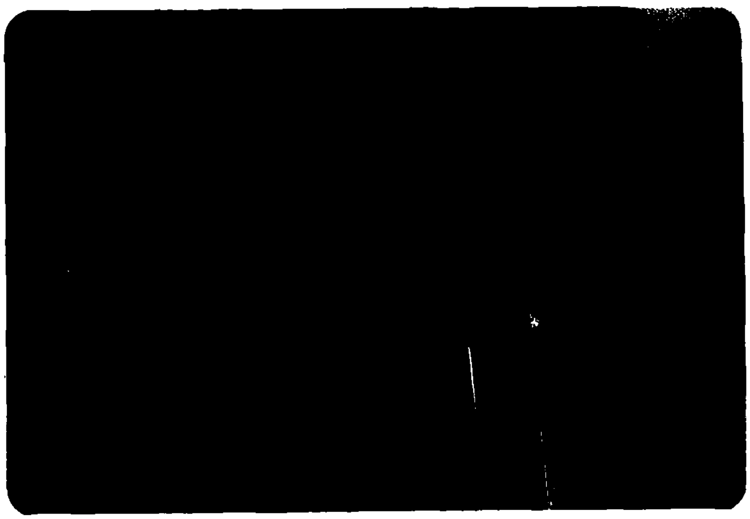
Bent 100 - Pile E. Approximately 50% marine borer and fungal section loss in upper intertidal zone.

PHOTOGRAPH No. 15

Bent 320 - Pile B. Approximately 30% loss of cross-sectional area due to fungal and/or marine borer damage in the intertidal zone.

PHOTOGRAPH No. 16

Bent 11C - Pile B. Level II cleaned pile in mid intertidal zone. Note density of fouling organisms and also excellent condition of pile.



PHOTOGRAPH No. 17

Bent 49C - Pile A. Level II cleaned pile at mudline. Note excellent condition of pile.

4.1.3 Structural Condition Assessment

The majority of the inspected timber piles were found to be in excellent condition. The pile loading capacity for all Level III inspected piles is given in the computer print-out, Table 3. This Table gives the P-ULT, ultimate capacity of the pile column in pounds, based on the measured parameters of length, original diameter and remaining cross-sectional area. For details on the program, see the appendices.

Of the 393 piles inspected in the Level III inspection, only two piles will require maintenance at this time. A total of 8 piles from the Level I inspection were found to have sustained significant damage and will also require restorative maintenance or replacement. In addition to the above significantly damaged piles, 6 piles from the Level III inspection and 30 piles from the Level I inspection were found to have sustained light attack or damage. As the damage to these piles is of a minor nature and does not significantly detract from the capacity of the piles, maintenance should not be required at this time. Periodic inspections should, however, be carried out to monitor the condition of these piles.

The concrete piling in Pier 3 are in excellent condition. Of the 200 piles inspected in the Level I inspection, 198 (99%) are undamaged; and 2 (1%) piles have sustained minor spalling. As this damage is of an insignificant or cosmetic nature, maintenance of these piles should not be required. All 50 piles cleaned and subjected to detailed Level II inspections were found to be in excellent condition. No evidence of damage was found and consequently, no maintenance will be required.

4.1.4 Recommendations

It is recommended that the two defective timber piles identified in the Level III inspection and detailed on Tables 2 and 3, be maintained. In addition, the 8 significantly damaged piles identified by the Level I inspection and listed below, should also be maintained. The defective piles are:

Bent	Row
10	C
14	S
35	C
40	G
100	E
105	G
149	G-Br
320	B

Effective maintenance of these piles could be achieved by the installation of a concrete jacket or alternately, as illustrated in Photograph No. 13, by driving a new replacement pile adjacent to the defective pile. The estimated unit cost per pile for either method is approximately \$2,000.00, therefore the total estimated cost for repairing the defects identified by this inspection is approximately \$20,000.00.

The total number of timber piles inspected in the Level I and Level III inspections is 1367. The total number of significantly damaged piles (10) represents only .7% of this total. When this level of damage is projected over the total 3783 timber piles in the structure, it is estimated that approximately 26 piles will require maintenance. The estimated cost of these repairs is approximately \$50,000.00. For a summary of required maintenance, see Table 7.

Given the excellent condition of the inspected concrete piles, no maintenance of these members will be required at this time.

Once the required maintenance to the timber piles has been carried out, the repairs should be re-inspected. This maintenance and re-inspection will serve to ensure the structural integrity of the facility.

In addition to the above re-inspection, it is also recommended that periodic inspections at three to five year intervals be carried out. These subsequent inspections will serve to identify any areas requiring maintenance and will thereby ensure the future structural integrity of the facility. All subsequent inspections should use this report as a datum or baseline.

4.2 PIER 4

4.2.1 Description

Pier 4 is located to the east of Pier 3 at NWSC. The Pier has two berths, numbers 5 and 6, which service ocean going AE ships. The pier is serviced by both vehicular and rail traffic.

The Pier was originally constructed in 1945 on creosote treated timber piling with a timber cap, stringer and deck superstructure. The original configuration of the Pier was crescent shaped with an approach trestle extending from the shore to an expanded width pierhead. A timber walkway or access trestle served to provide light vehicle and pedestrian traffic to the pierhead. In 1966 major modifications to the facility were carried out. These changes included the widening of the pierhead section and the installation of a second approach trestle continuous with the eastern end of the pierhead. Once completed, the new trestle allowed for a one way roll-on/roll-off traffic pattern. The section of the structure added in 1966 was constructed on prestressed concrete piles.

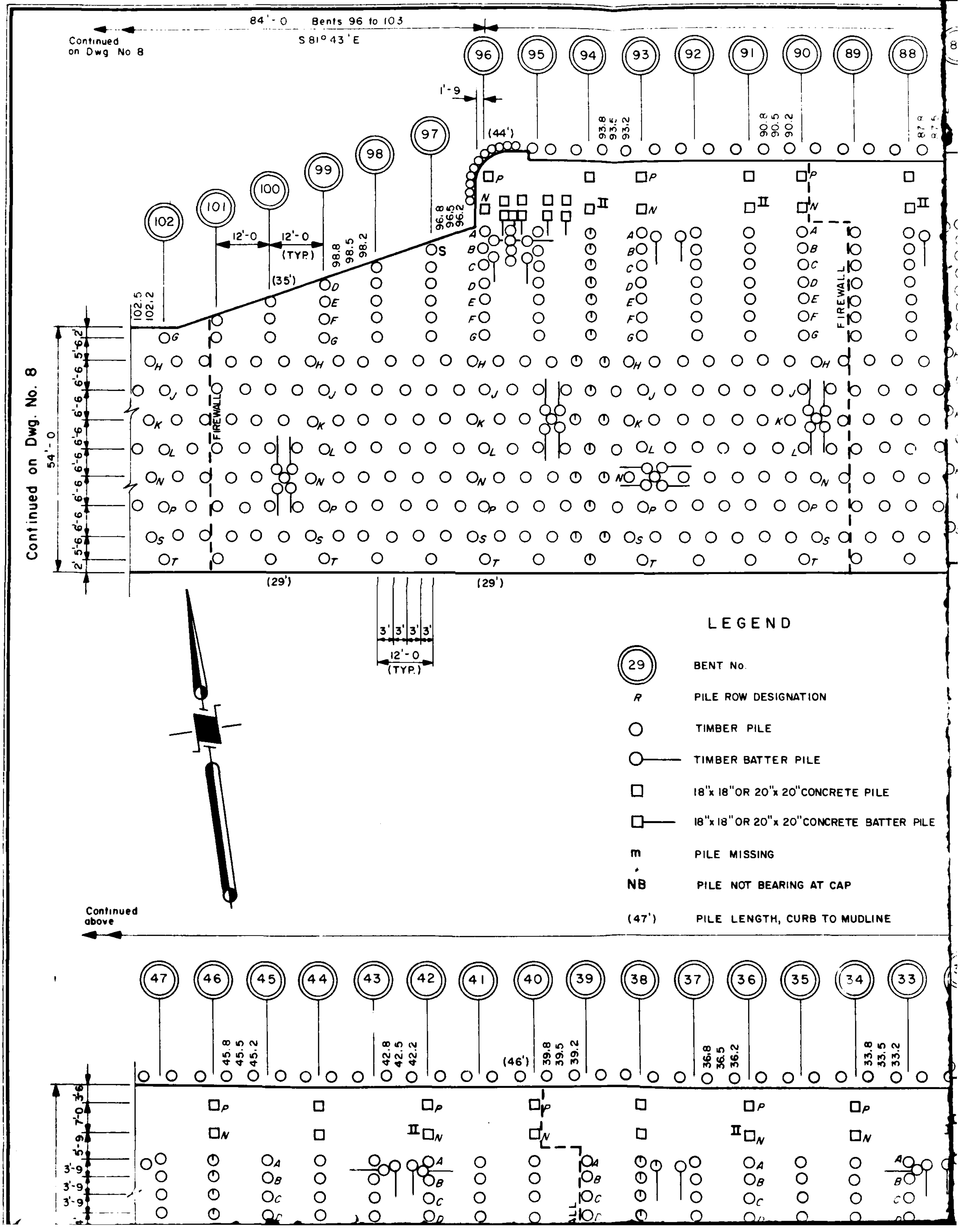
For the purposes of this inspection, the structure was subdivided into four sections. As shown in Drawings 7 - 11, these sections are identified as the (1) Pierhead; (2) Approachway Trestle (photograph No. 18); (3) Access Trestle; and (4) Concrete Trestle (photograph No. 19). For identification purposes, the piles within each of these sections have been designated bent and row numbers based on the identification system used in NAVFAC Reference Drawings: 11242-B4; 11242-B5; 11242-8; 11242-9; 1115132; 1115146 and 1115148.

Pile lengths along the berth face in the pierhead section were found to be approximately 40 feet from mudline to cap. Measurements of the pile lengths were taken at intervals throughout the facility.

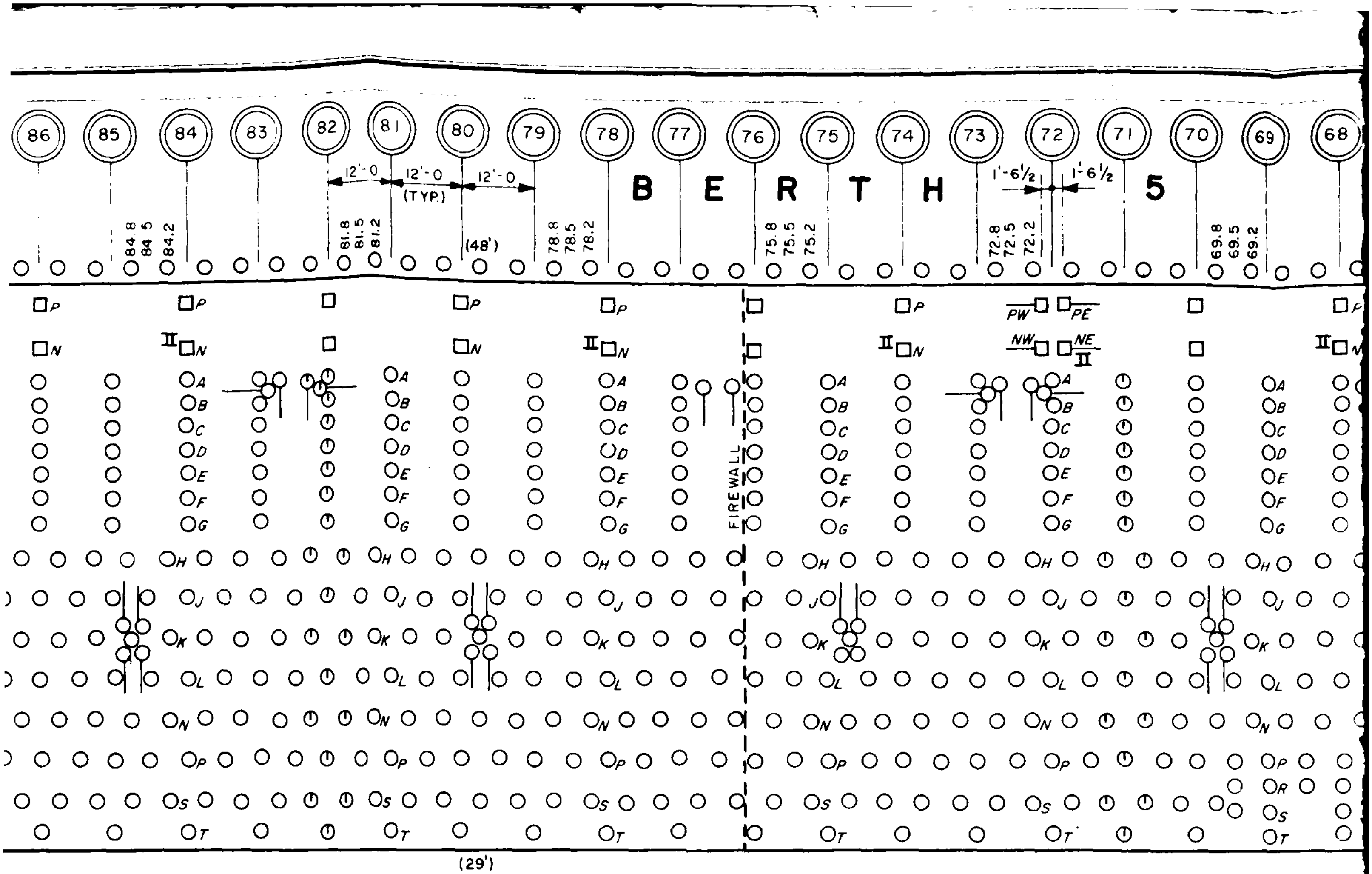
These lengths are detailed in the accompanying drawings. In several areas, extensive silting of the mudline has occurred resulting in shallow water.

The timber pile diameters were found to average approximately 12". As detailed on Drawing No. 10 the concrete piles are either 20" or 18" square, depending on their location within the structure.

At the time of the inspection the underwater visibility ranged from zero to a maximum of 1 foot. Current conditions at the site ranged from minimal at slack tide to approximately 3 knots during the ebb tide.



84'-0 Bents 96 to 103
S 81° 43' E
Continued on Dwg No 8
Continued on Dwg. No. 8
54'-0
FIREWALL
FIREWALL
1'-9
(44')
(35')
(29')
(29')
12'-0
12'-0 (TYP.)
3' 3' 3' 3'
12'-0 (TYP.)
Continued above
(46')
LEGEND
29 BENT No.
R PILE ROW DESIGNATION
TIMBER PILE
TIMBER BATTER PILE
18"x 18" OR 20"x 20" CONCRETE PILE
18"x 18" OR 20"x 20" CONCRETE BATTER PILE
m PILE MISSING
NB PILE NOT BEARING AT CAP
(47') PILE LENGTH, CURB TO MUDLINE



INSPECTION LEVEL DESIGNATIONS

LEVEL I - all perimeter piles from bents 4C to 102

- all piles in every fifth bent, i.e. 1, 5, 10, 15 etc to 100, and bent 1C

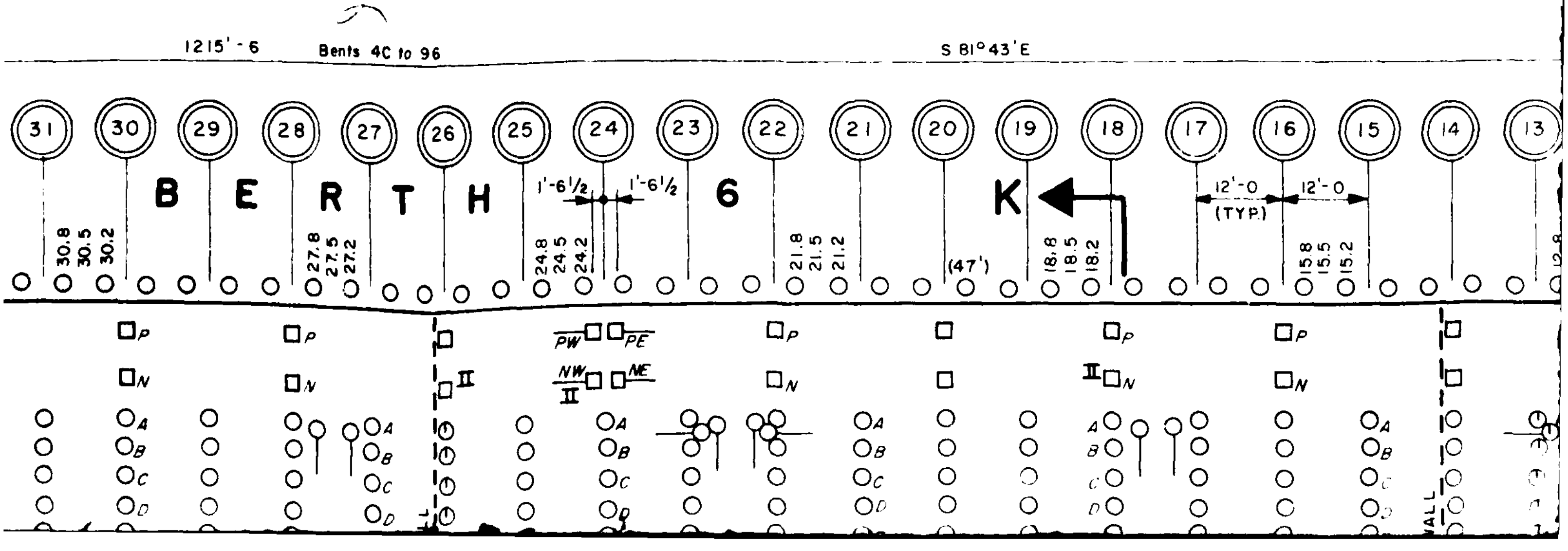
S - SIGNIFICANTLY DAMAGED PILE

LEVEL II - inspected piles indicated by (II)

* - SIGNIFICANTLY DAMAGED PILE

LEVEL III - inspected piles indicated by ;

- 100% REMAINING CROSS-SECTIONAL AREA
- 75% REMAINING CROSS-SECTIONAL AREA
- 50% REMAINING CROSS-SECTIONAL AREA
- 25% REMAINING CROSS-SECTIONAL AREA
- 0-25% REMAINING CROSS-SECTIONAL AREA



AD-A168 461 UNDERWATER FACILITIES INSPECTION AND ASSESSMENT AT NAVAL WEAPONS STATION..(U) AGI (J) AND ASSOCIATES INC SEATTLE WA MAY 83 CHES/NAVFAC-FPO-1-83-(19) 2/2

UNCLASSIFIED N62477-81-C-0498 F/G 13/2 NL

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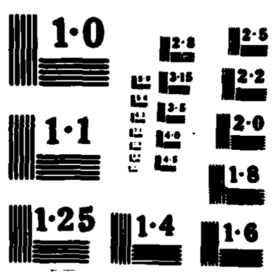
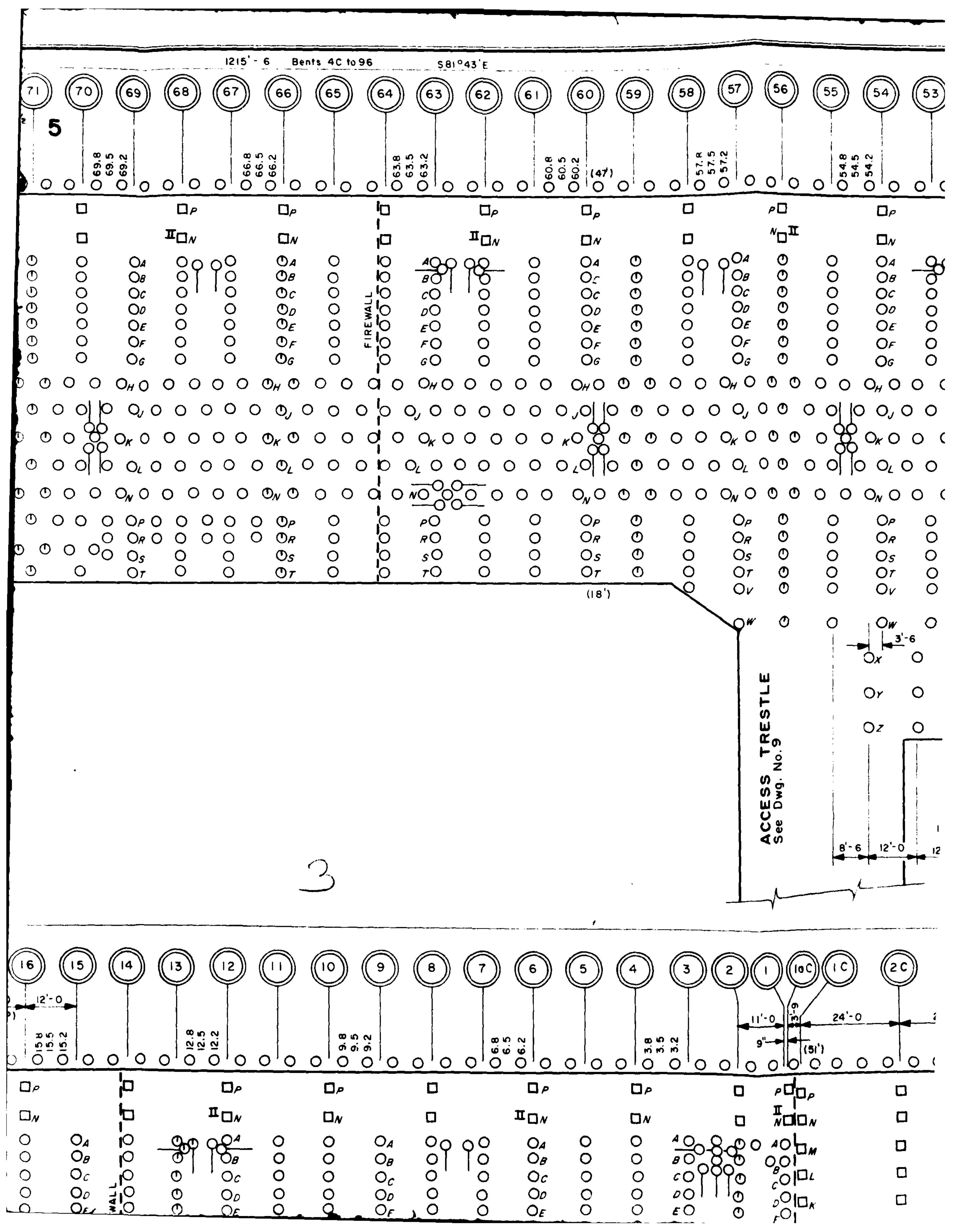
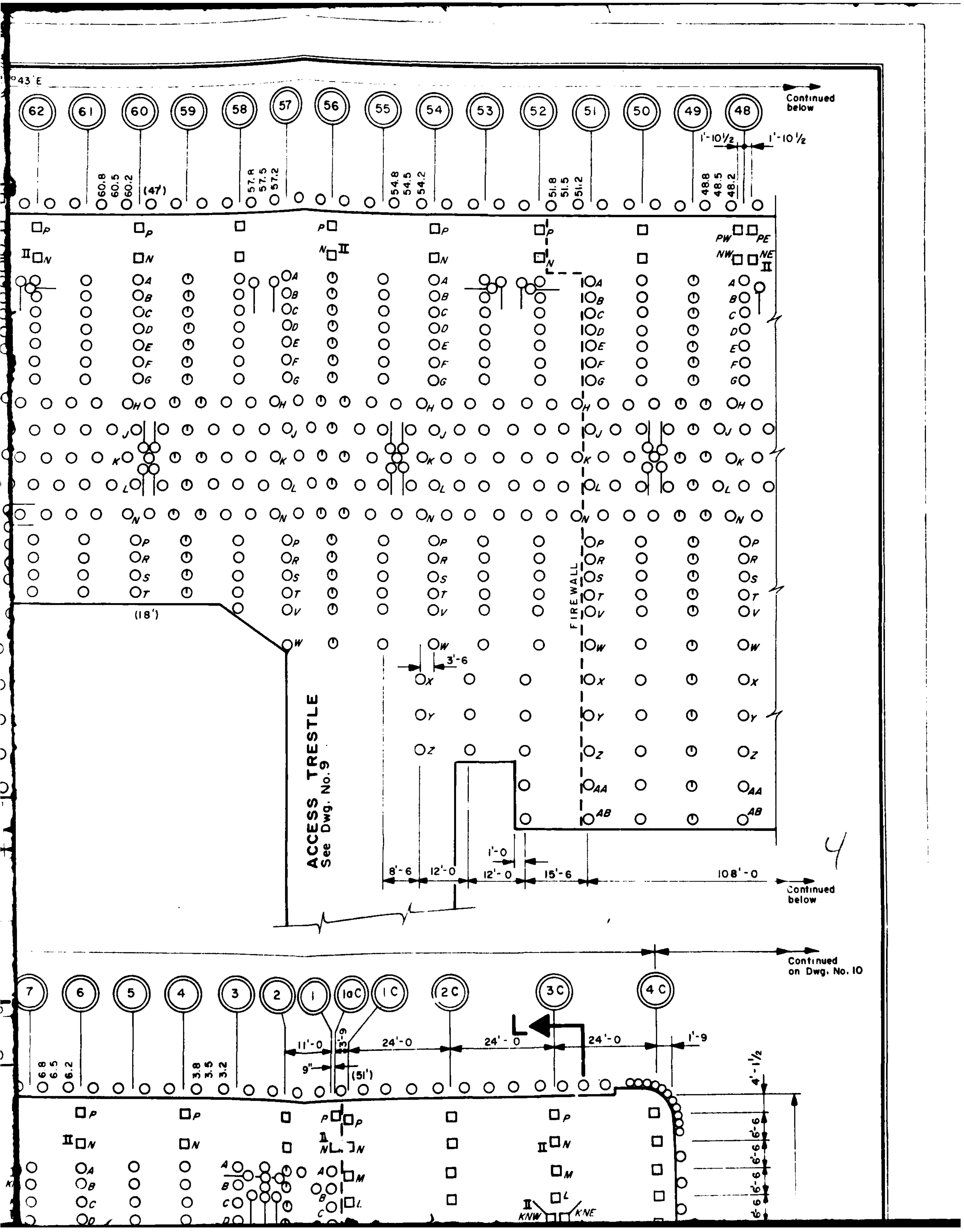
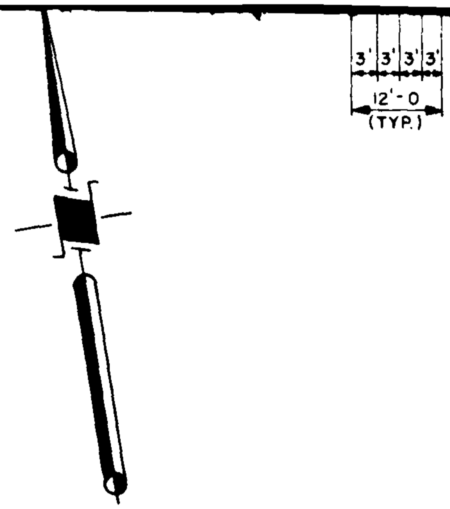

1·0
1·1
1·25
1·4
1·6
1·8
2·0
2·2
2·5


1215'-6 Bents 4C to 96
S81°43'E
5
(47')
FIREWALL
(18')
3'-6
ACCESS TRESTLE
See Dwg. No. 9
8'-6
12'-0
3
12'-0
11'-0
3'-9
24'-0
9"
(51')
WALL

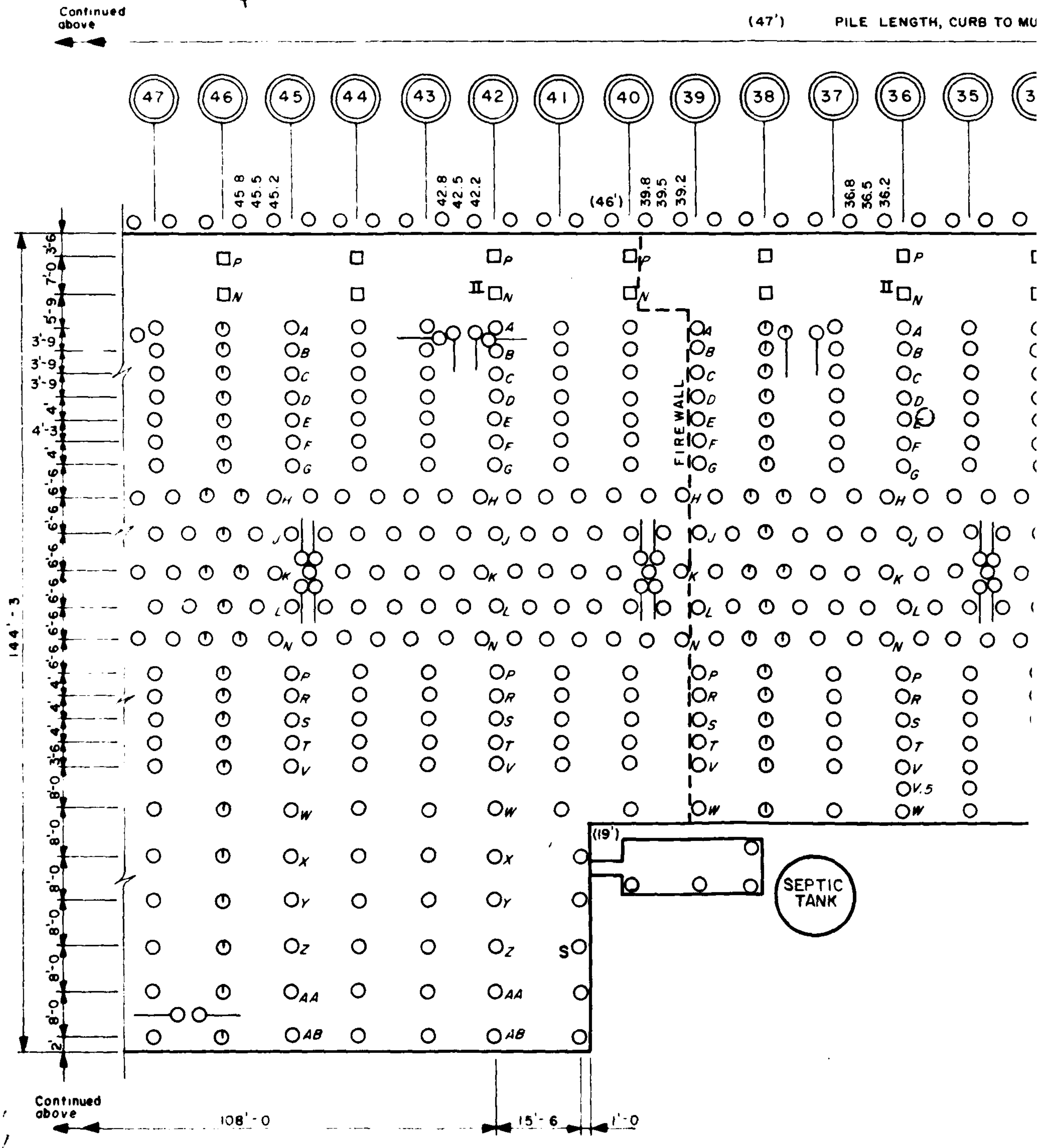


43'E
62
61
60
59
58
57
56
55
54
53
52
51
50
49
48
Continued below
1'-10 1/2
1'-10 1/2
60.8
60.5
60.2
(47)
57.8
57.5
57.2
54.8
54.5
54.2
51.8
51.5
51.2
48.8
48.5
48.2
FIREWALL
(18')
3'-6
ACCESS TRESTLE
See Dwg. No. 9
1'-0
8'-6
12'-0
12'-0
15'-6
108'-0
Continued below
Continued on Dwg. No. 10
7
6
5
4
3
2
1
1aC
1C
2C
3C
4C
11'-0
3'-9
24'-0
24'-0
24'-0
1'-9
9"
(51')
6.8
6.5
6.2
3.8
3.5
3.2
4'-1 1/2
6'-6
6'-6
6'-6
6'-6
KNW
KNE
4



LEGEND

(29)	BENT No
R	PILE ROW DESIGNATION
○	TIMBER PILE
○—	TIMBER BATTER PILE
□	18"x 18" OR 20"x 20" CONCRETE
□—	18"x 18" OR 20"x 20" CONCRETE
m	PILE MISSING
NB	PILE NOT BEARING AT CAP
(47')	PILE LENGTH, CURB TO MU



INSPECTION LEVEL DESIGNATIONS

LEVEL I - all perimeter piles from bents 4C to 102
- all piles in every fifth bent, i.e. 1, 5, 10, 15 etc to 100, and bent 1C
S - SIGNIFICANTLY DAMAGED PILE

LEVEL II - inspected piles indicated by (II)
* - SIGNIFICANTLY DAMAGED PILE

LEVEL III - inspected piles indicated by ;
100% REMAINING CROSS-SECTIONAL AREA
75% REMAINING CROSS-SECTIONAL AREA
50% REMAINING CROSS-SECTIONAL AREA
25% REMAINING CROSS-SECTIONAL AREA
0-25% REMAINING CROSS-SECTIONAL AREA

TION

ILE

CONCRETE PILE

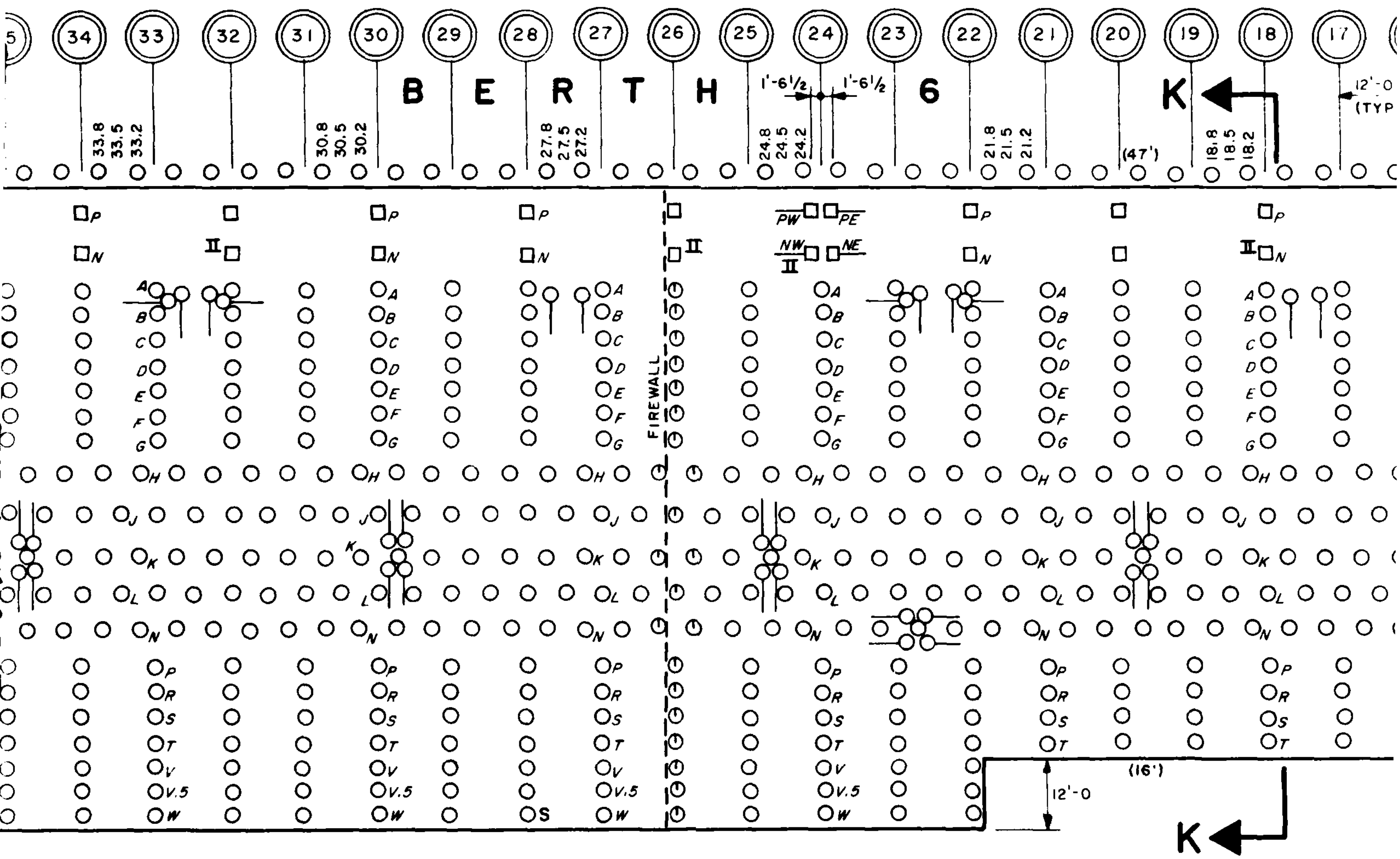
CONCRETE BATTER PILE

AT CAP

IRB TO MUDLINE

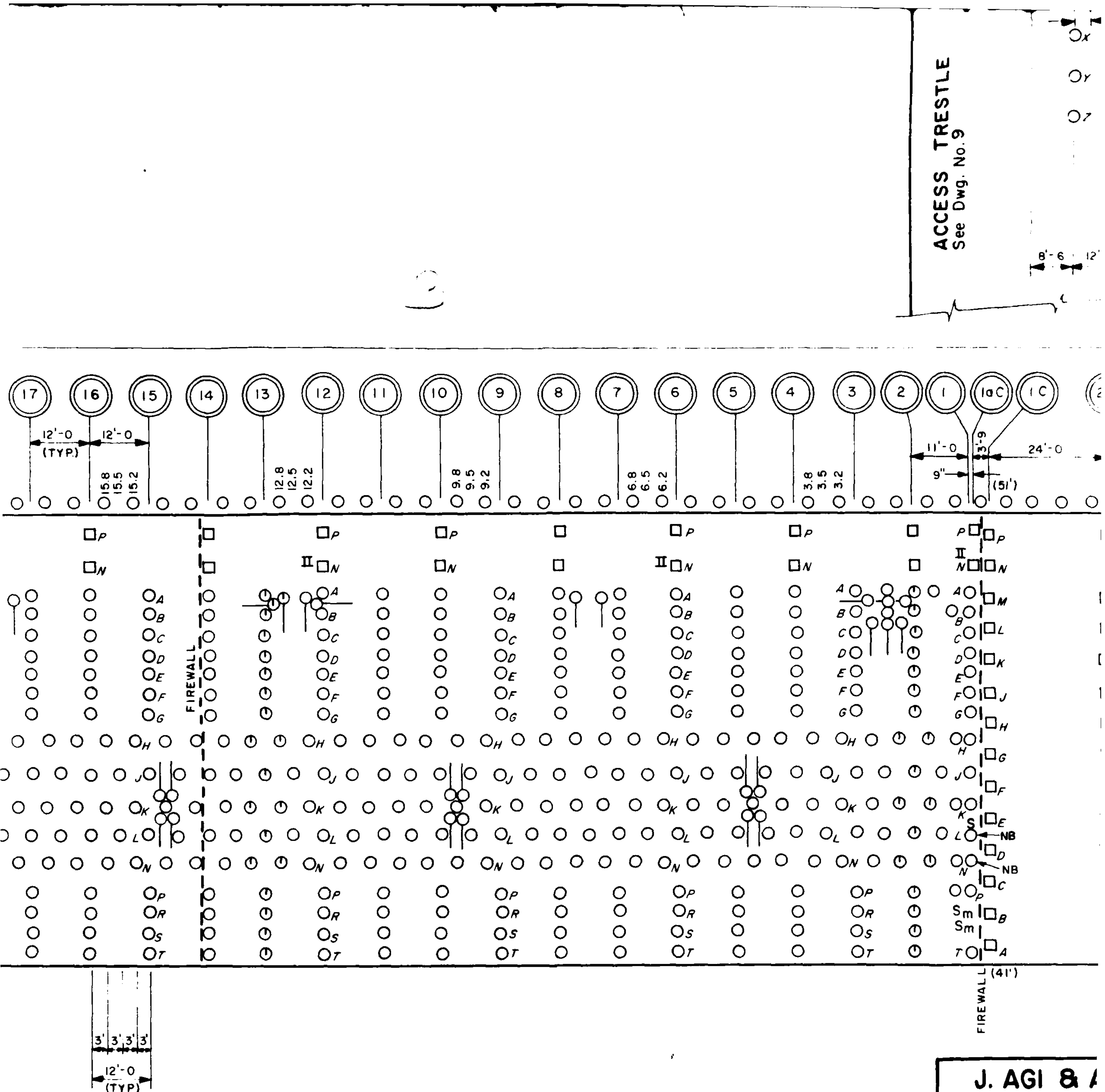
2

1215'-6 Bents 4C to 96 S 81° 43' E



No

6



PIER 4, Reference Drawings

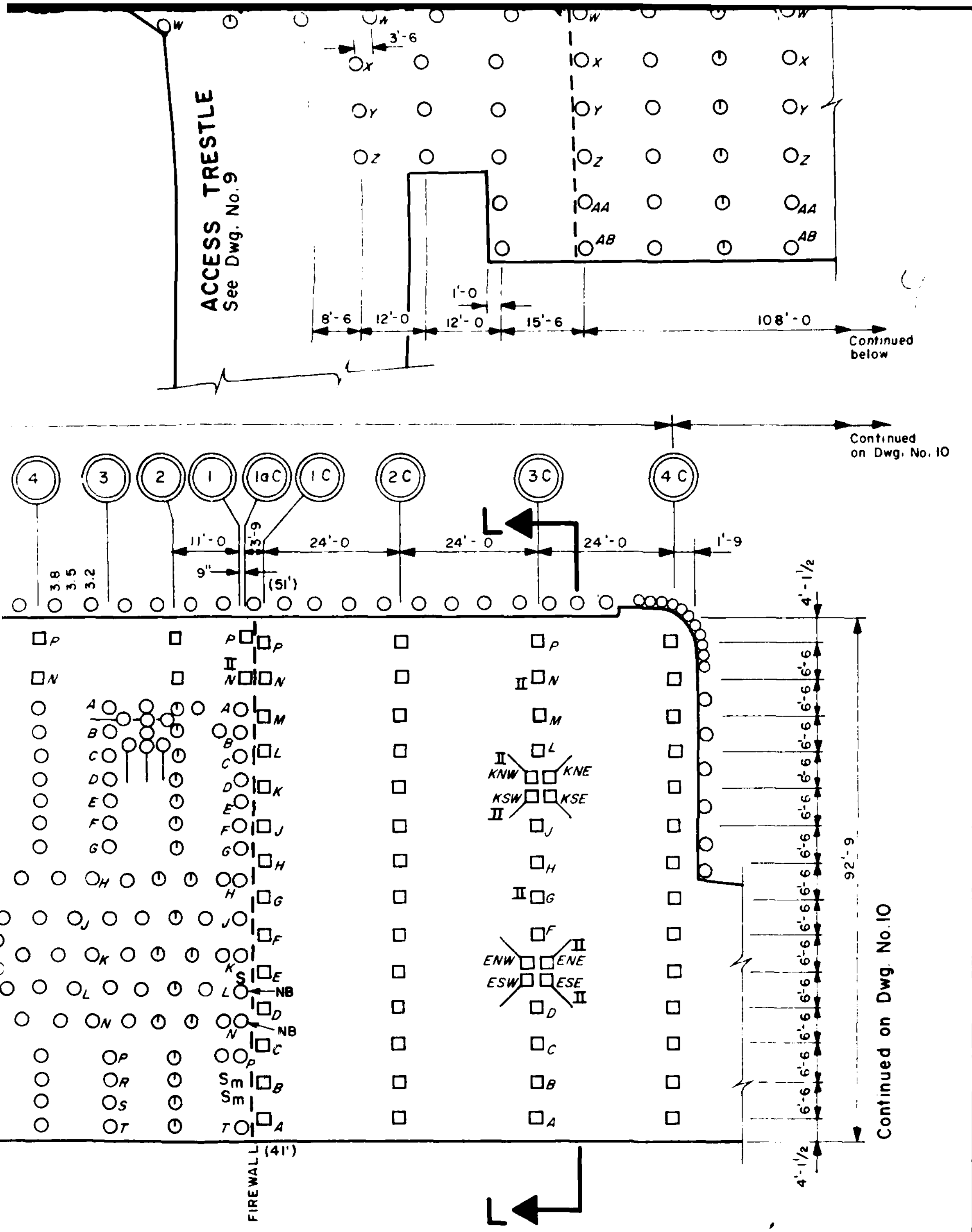
P.W. Dwg. No
11266-B4
11266-B5
11242-8
11242-9

Y and D Dwg. No
1115132
1115146
1115148

Note : 18" concrete piles, bents IaC to 96C
20" concrete piles, bents 1C to 4C

J. AGI & A
Suite 600,

PLA
AND CONDIT
F
U.S. NA
CC
CHES
REPOF
CONTRAC



J. AGI & ASSOCIATES CO. LTD.
Suite 600, 1414 Alaskan Way, Seattle, WA

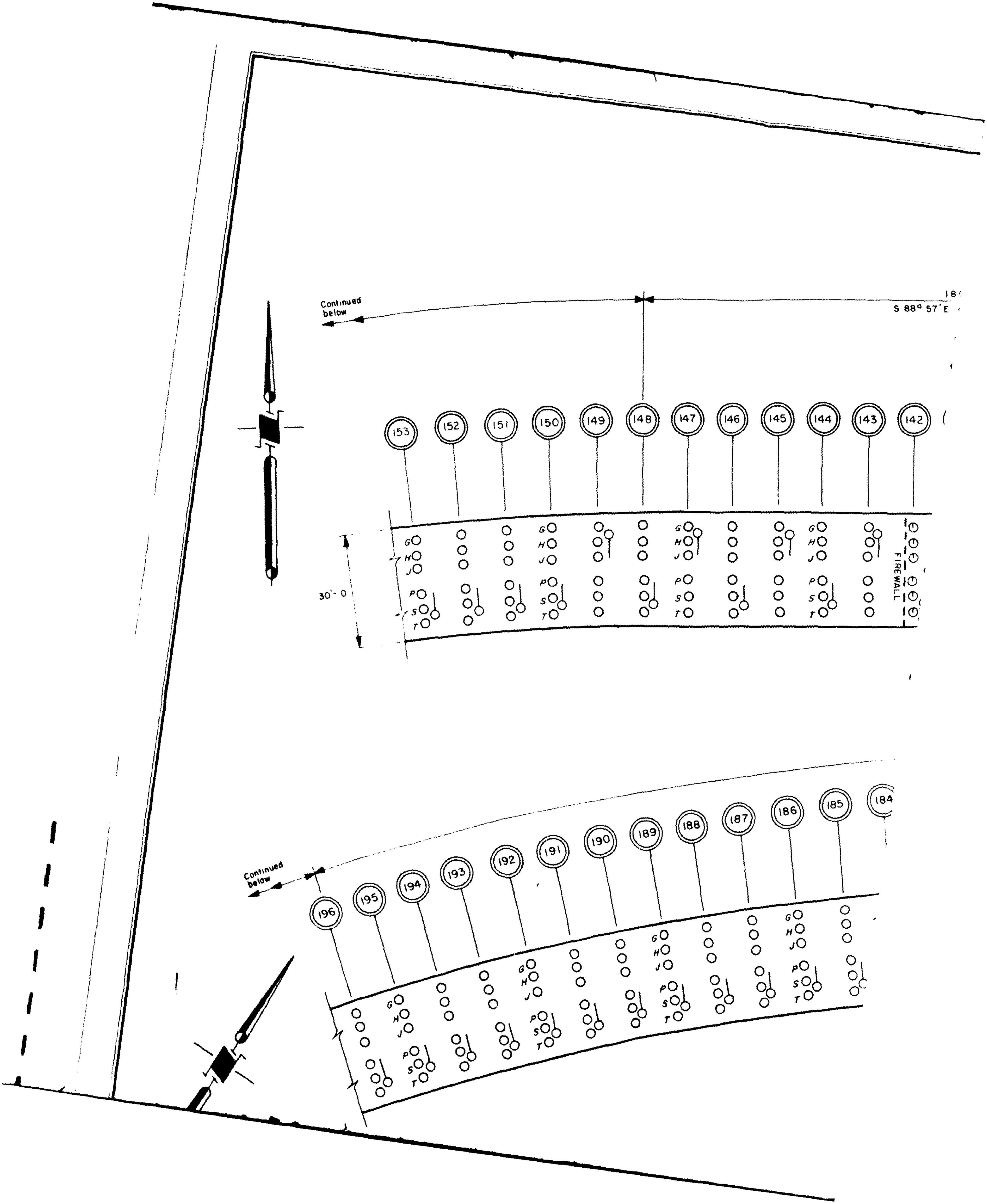
PLAN SHOWING LOCATION
AND CONDITION OF INSPECTED PILING IN
PIER 4, PIERHEAD
U.S NAVAL WEAPONS STATION
CONCORD, CALIFORNIA

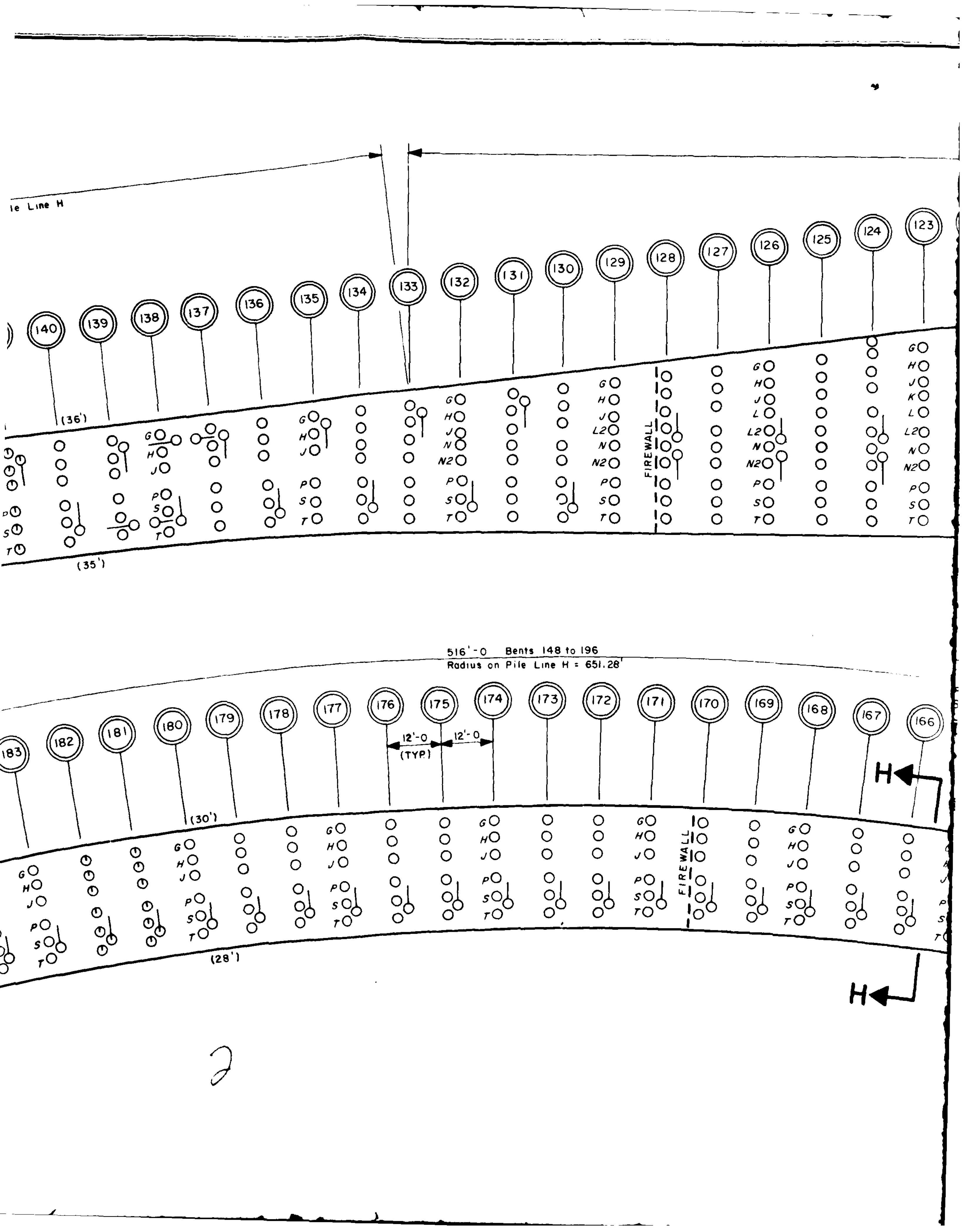
CHES DIV NAV FAC ENG COM
REPORT No FPO-1-83-(19)
CONTRACT No N62477-81-C-0498
TASK 2

DWG. No. 7

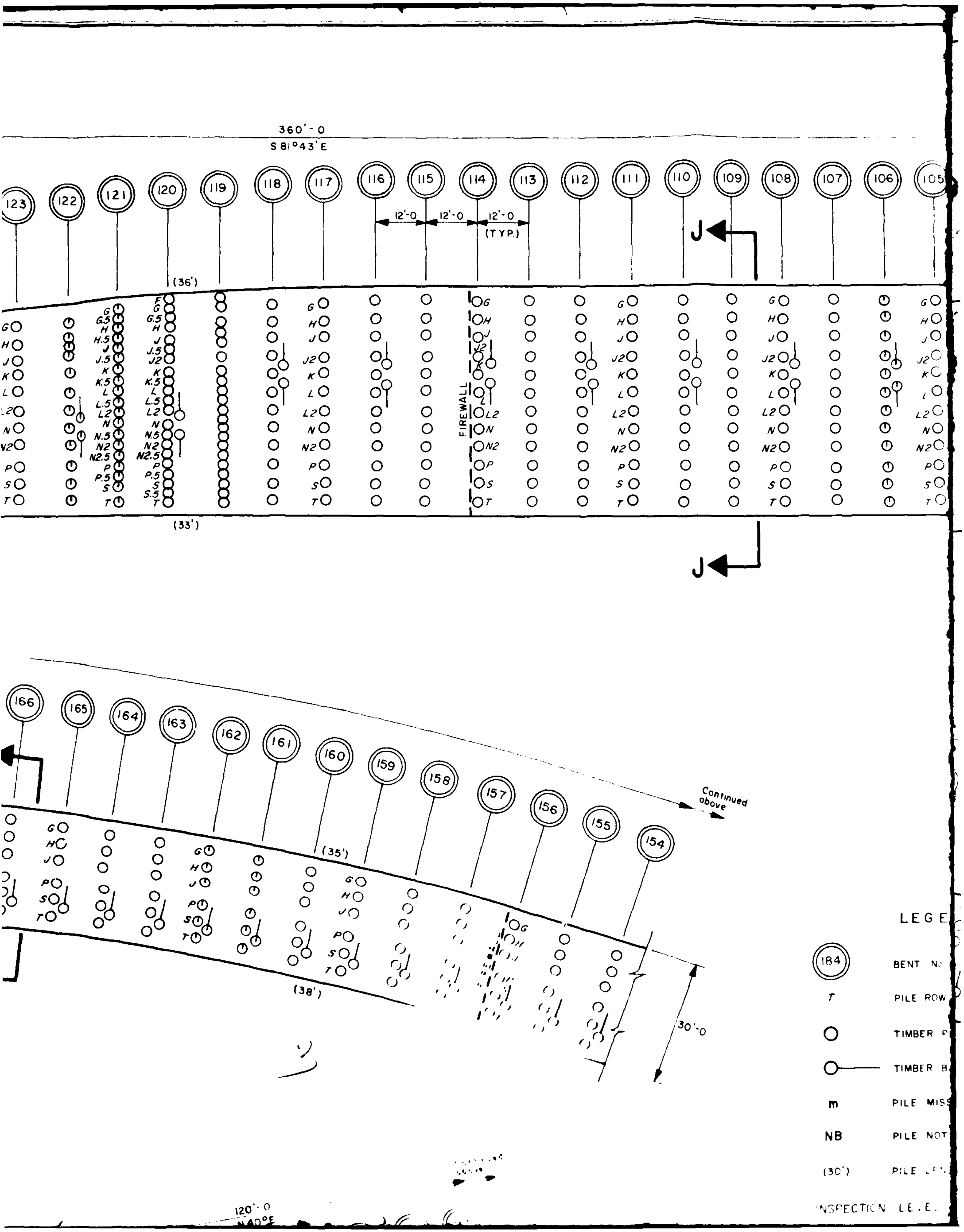
SCALE	1" = 20'
DRAWN	F P
CHECKED	J.I.
APPROVED	XIE
DATE	JUNE 6, 1983.
PROJECT No.	83-1/3-2-100

ngs

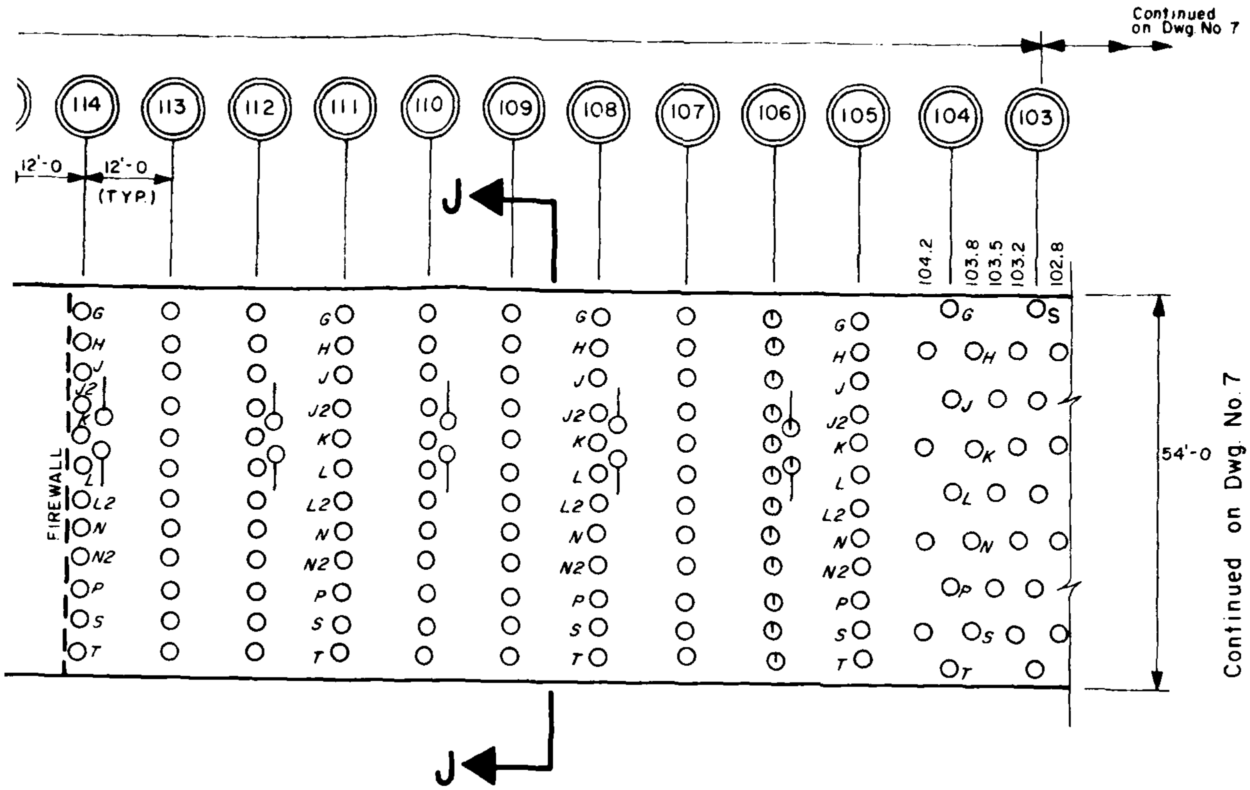

Continued below
S 88° 57' E
153
152
151
150
149
148
147
146
145
144
143
142
G
H
J
P
S
T
FIREWALL
30'-0
Continued below
196
195
194
193
192
191
190
189
188
187
186
185
184

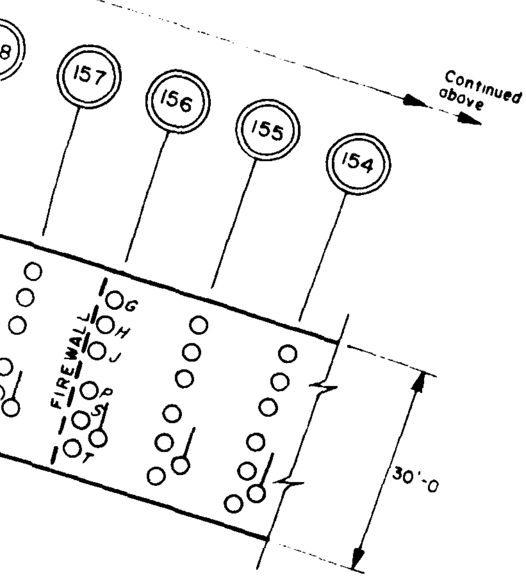


le Line H
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
(36')
(35')
FIREWALL
G
H
J
K
L
L2
N
N2
P
S
T
516'-0 Bents 148 to 196
Radius on Pile Line H = 651.28'
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
12'-0
(TYP)
12'-0
(30')
(28')
H
H



360'-0
S 81°43' E
123
122
121
120
119
118
117
116
115
114
113
112
111
110
109
108
107
106
105
12'-0
12'-0
12'-0
(TYP.)
J
(36')
(33')
FIREWALL
F
G
G.5
H
H.5
J
J.5
J2
K
K.5
L
L.5
L2
N
N.5
N2
N2.5
P
P.5
S
S.5
T
166
165
164
163
162
161
160
159
158
157
156
155
154
Continued above
(35')
(38')
30'-0
LEGE
184
BENT N
PILE ROW
TIMBER P
TIMBER B
m
PILE MISS
NB
PILE NOT
(30')
PILE LEN
INSPECTION LEVE
120'-0
N40°E

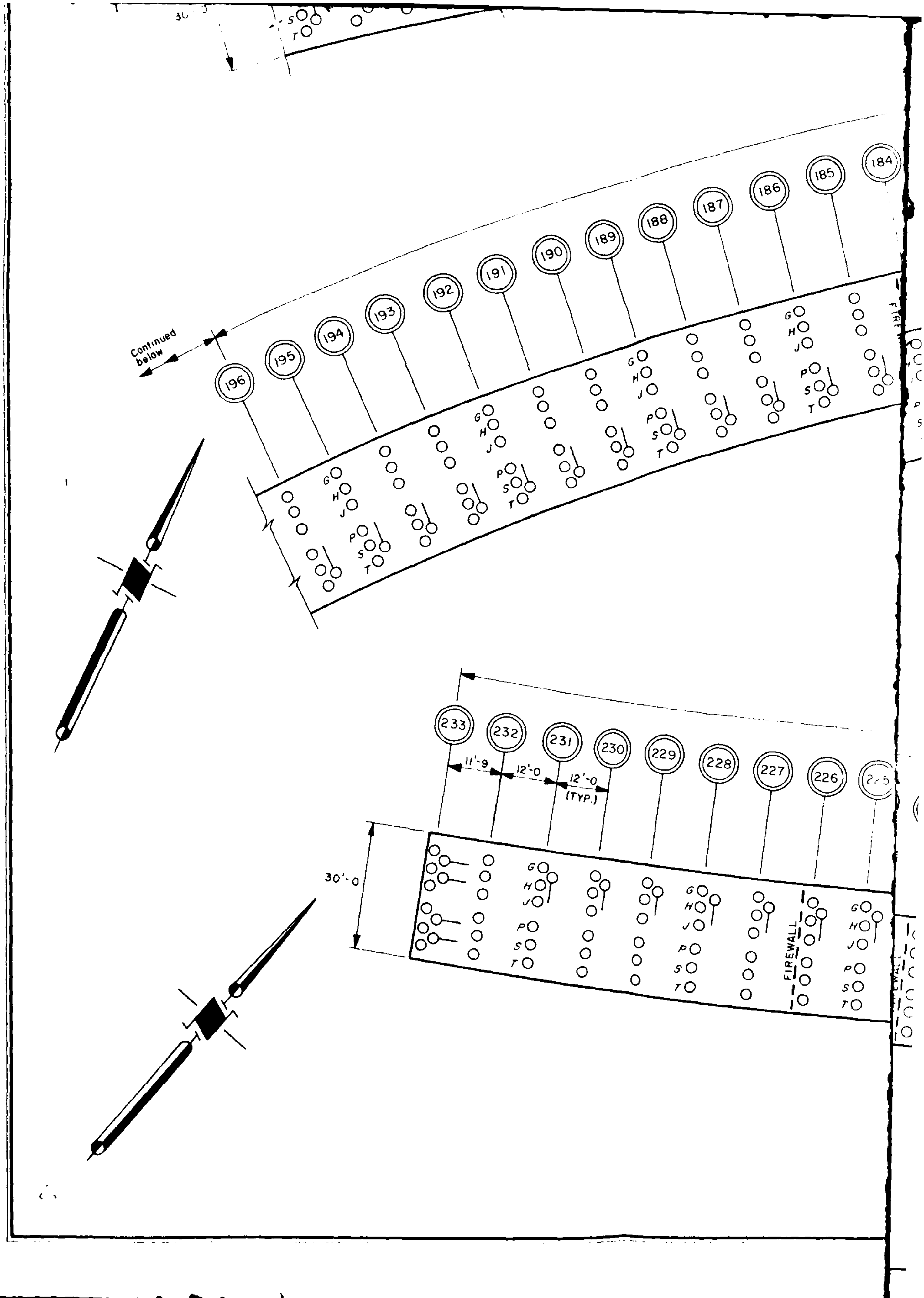




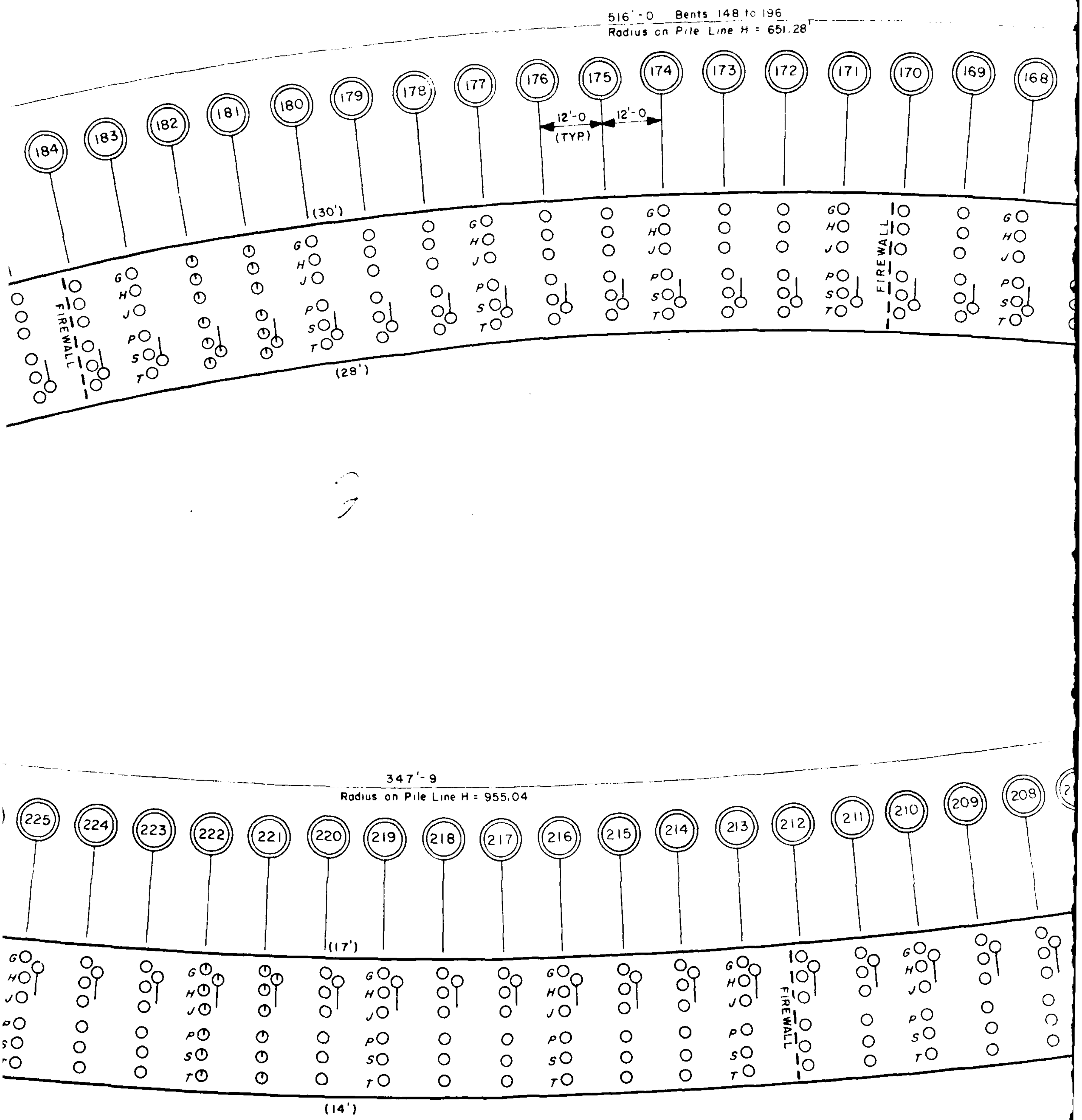
LEGEND

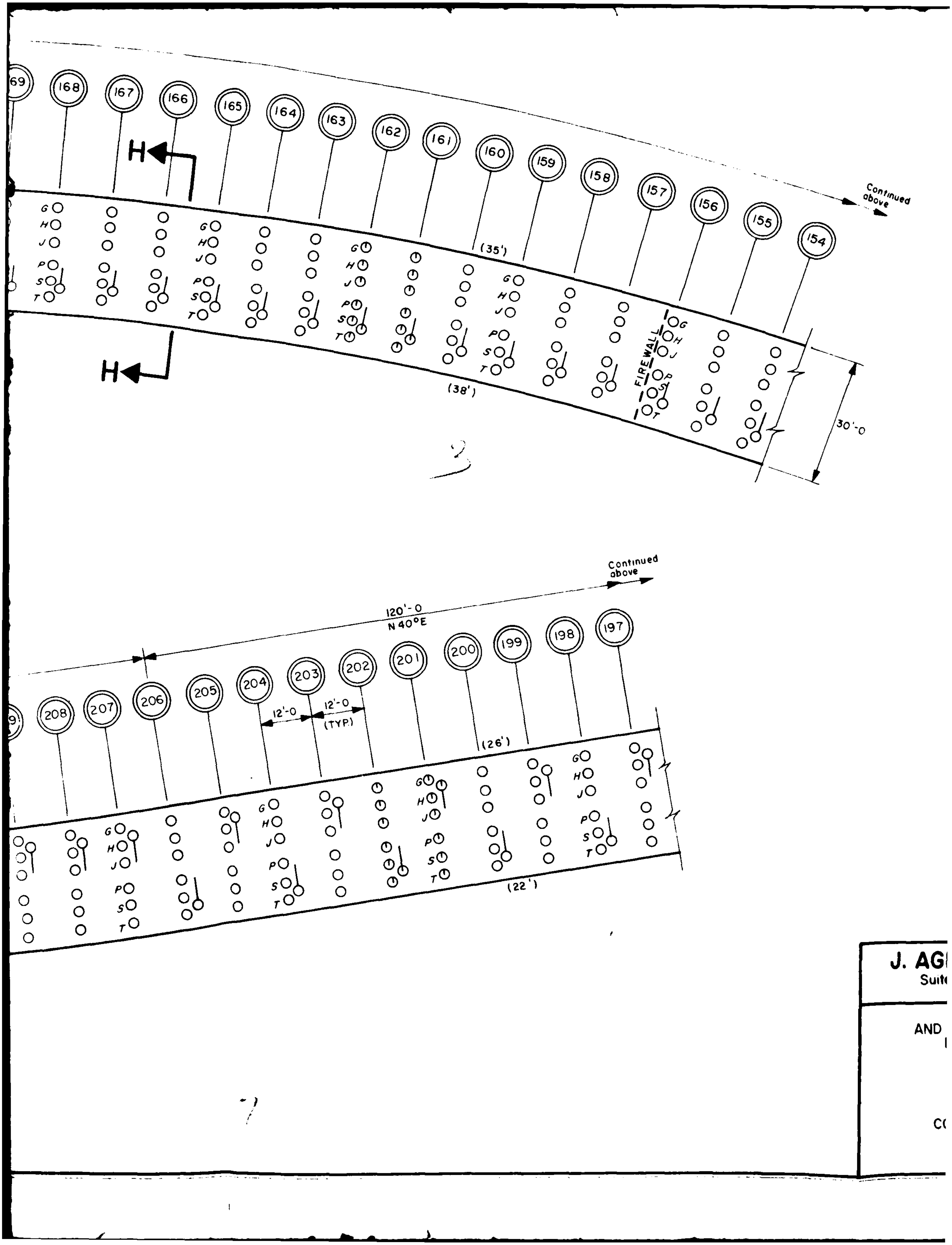
184	BENT No.
T	PILE ROW DESIGNATION
○	TIMBER PILE
○——	TIMBER BATTER PILE
m	PILE MISSING
NB	PILE NOT BEARING AT CAP
(30')	PILE LENGTH, CURB TO MUDLINE

INSPECTION LEVEL DESIGNATIONS

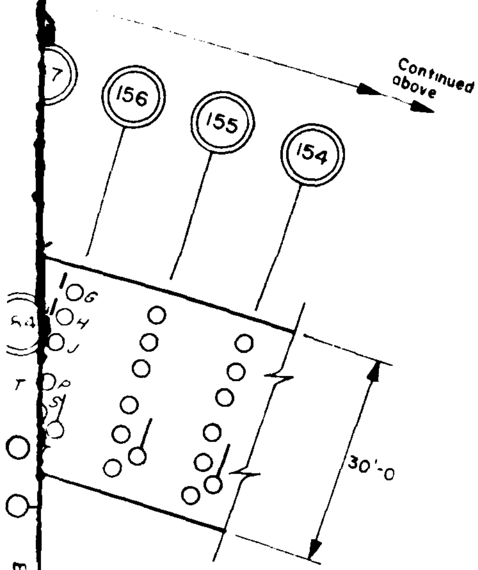


Continued below
196
195
194
193
192
191
190
189
188
187
186
185
184
G
H
J
P
S
T
FIREWALL
233
232
231
230
229
228
227
226
11'-9
12'-0
12'-0
(TYP.)
30'-0


516'-0 Bents 148 to 196
Radius on Pile Line H = 651.28'
184 183 182 181 180 179 178 177 176 175 174 173 172 171 170 169 168
12'-0
12'-0
(TYP.)
(30')
(28')
G H J P S T
FIREWALL
347'-9
Radius on Pile Line H = 955.04
225 224 223 222 221 220 219 218 217 216 215 214 213 212 211 210 209 208
(17')
(14')



169
168
167
166
165
164
163
162
161
160
159
158
157
156
155
154
H
H
Continued above
G H J P S T
(35')
(38')
FIREWALL
30'-0
Continued above
120'-0
N 40°E
209
208
207
206
205
204
203
202
201
200
199
198
197
12'-0
12'-0
(TYP.)
(26')
(22')
J. AG
Suit
AND
CC



LEGEND

(184)	BENT No.
T	PILE ROW DESIGNATION
○	TIMBER PILE
○——	TIMBER BATTER PILE
m	PILE MISSING
NB	PILE NOT BEARING AT CAP
(30')	PILE LENGTH, CURB TO MUDLINE

INSPECTION LEVEL DESIGNATIONS

LEVEL I - all perimeter piles from bents 103 to 230
- all piles in every fifth bent from 105 to 220

S SIGNIFICANTLY DAMAGED PILE

LEVEL III - inspected piles indicated by;

- 100% REMAINING CROSS-SECTIONAL AREA
- 75% REMAINING CROSS-SECTIONAL AREA
- 50% REMAINING CROSS-SECTIONAL AREA
- 25% REMAINING CROSS-SECTIONAL AREA
- 0 - 25% REMAINING CROSS-SECTIONAL AREA

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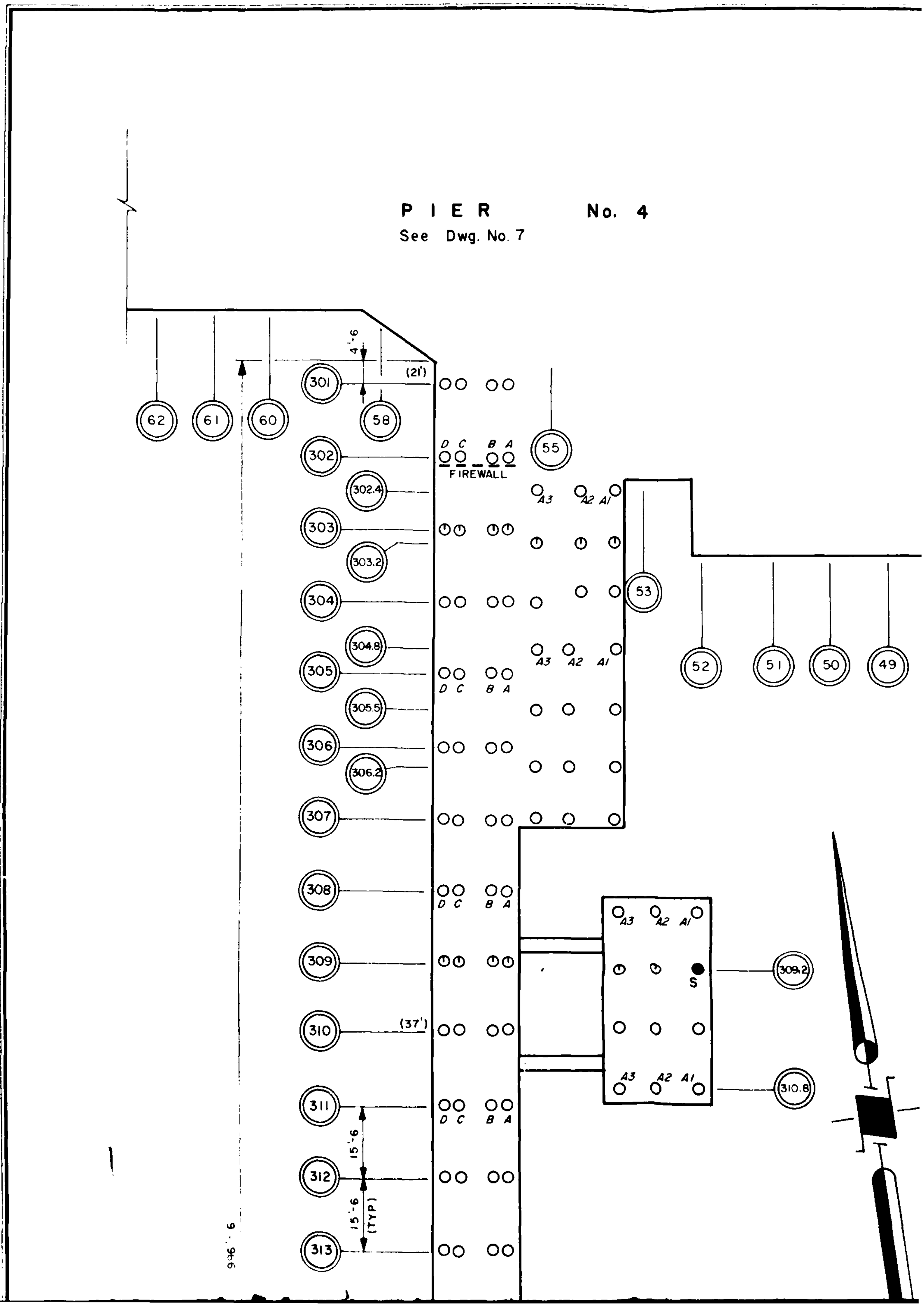
Suite 600, 1414 Alaskan Way, Seattle, WA

PLAN SHOWING LOCATION
AND CONDITION OF INSPECTED PILING IN
PIER 4, APPROACHWAY TRESTLE
U.S. NAVAL WEAPONS STATION
CONCORD, CALIFORNIA

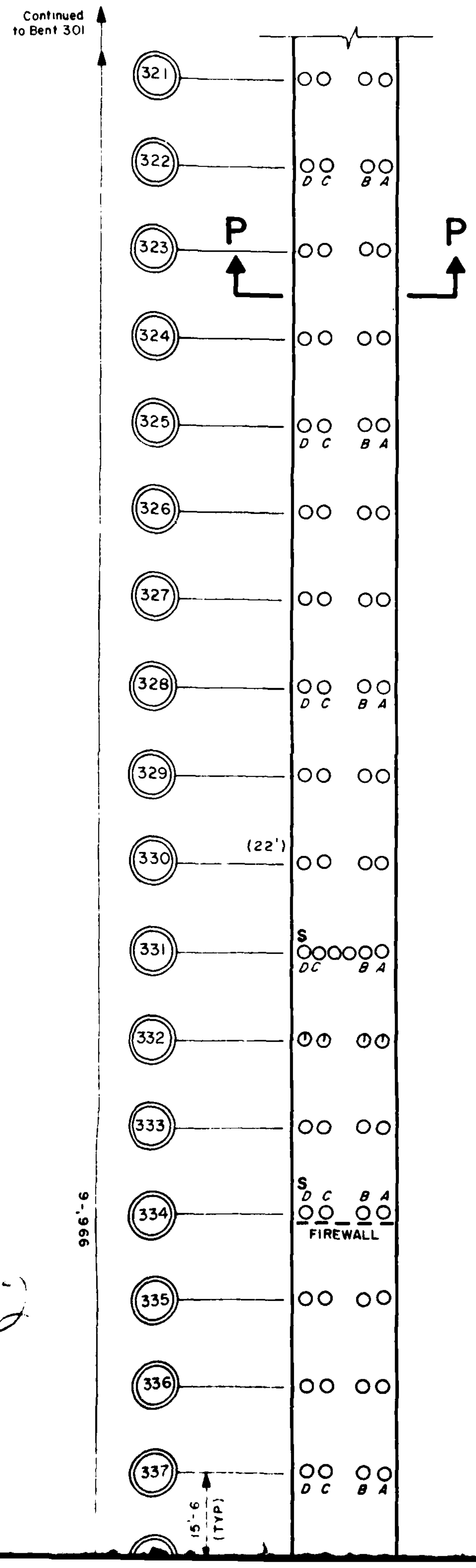
CHES DIV NAV FAC ENG COM
REPORT No. FPO-1-83-(19)
CONTRACT No. N62477-81-C-0498
TASK 2

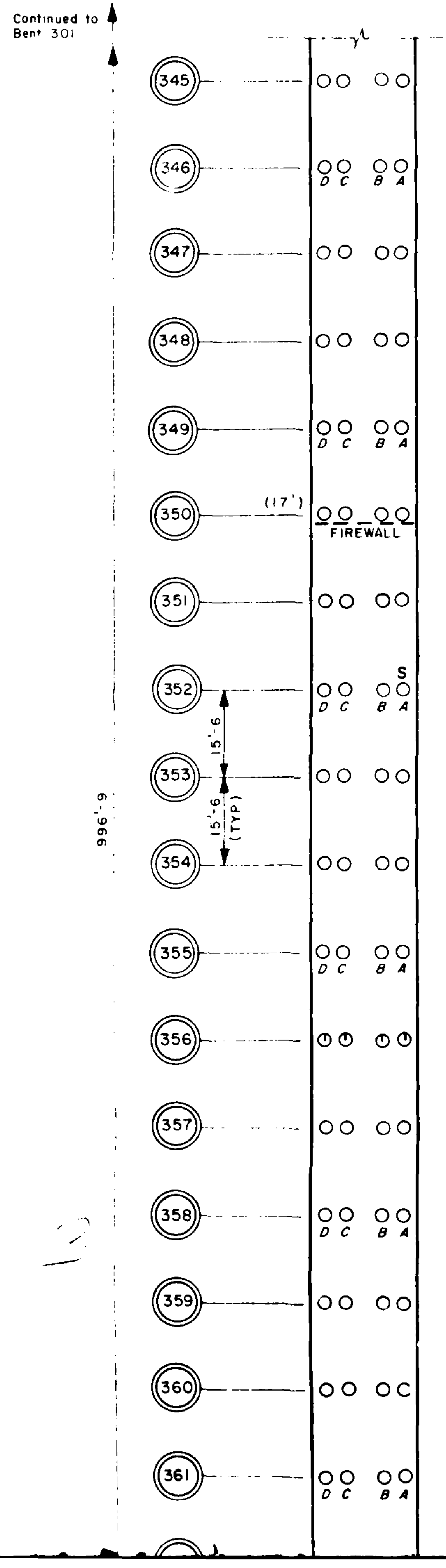
DWG. No. 8

SCALE	1" = 20'
DRAWN	F P
CHECKED	J.P.
APPROVED	XIIE
DATE	JUNE 7, 1983
PROJECT No	83-1/3-2-100



PIER No. 4
See Dwg. No. 7
FIREWALL
62
61
60
58
55
53
52
51
50
49
301
302
302.4
303
303.2
304
304.8
305
305.5
306
306.2
307
308
309
309.2
310
310.8
311
312
313
(21')
(37')
4'-6
15'-6
15'-6 (TYP)
946'-6
D C B A
A3 A2 A1
S


Continued to Bent 301
321
322
D C B A
P
P
323
324
325
D C B A
326
327
328
D C B A
329
(22')
330
S
331
D C B A
332
333
S
D C B A
334
FIREWALL
996'-6
335
336
337
D C B A
15'-6 (TYP)



LEGEND

(335)	BENT No
B	PILE ROW DESIGNATION
○	TIMBER PILE
○——	TIMBER BATTER PILE
m	PILE MISSING
NB	PILE NOT BEARING AT CAP
(22')	PILE LENGTH, CAP TO MUD

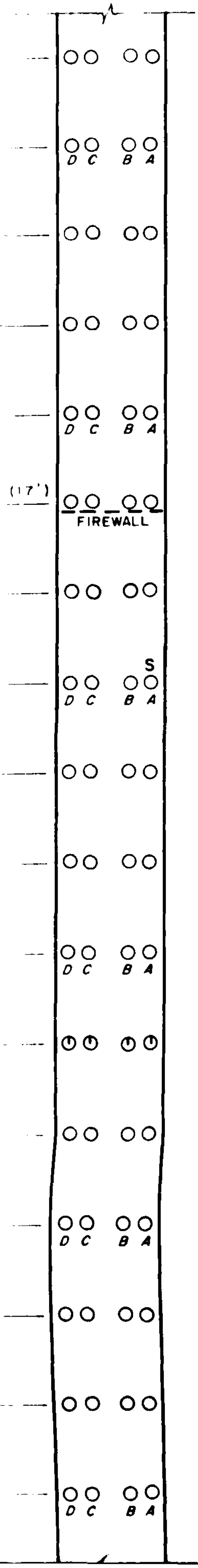
INSPECTION LEVEL DESIGNATION

LEVEL I - all perimeter piles
and 302.4 to 36
- all piles in bents 30
340, 345, 350, 3

S SIGNIFICANTLY DAMA

LEVEL III - inspected piles indic

- 100% REMAINING CR
- 75% REMAINING CR
- 50% REMAINING CR
- 25% REMAINING CR
- 0 - 25% REMAINING



LEGEND

(335)	BENT No.
B	PILE ROW DESIGNATION
O	TIMBER PILE
O——	TIMBER BATTER PILE
m	PILE MISSING
NB	PILE NOT BEARING AT CAP
(22')	PILE LENGTH, CAP TO MUDLINE

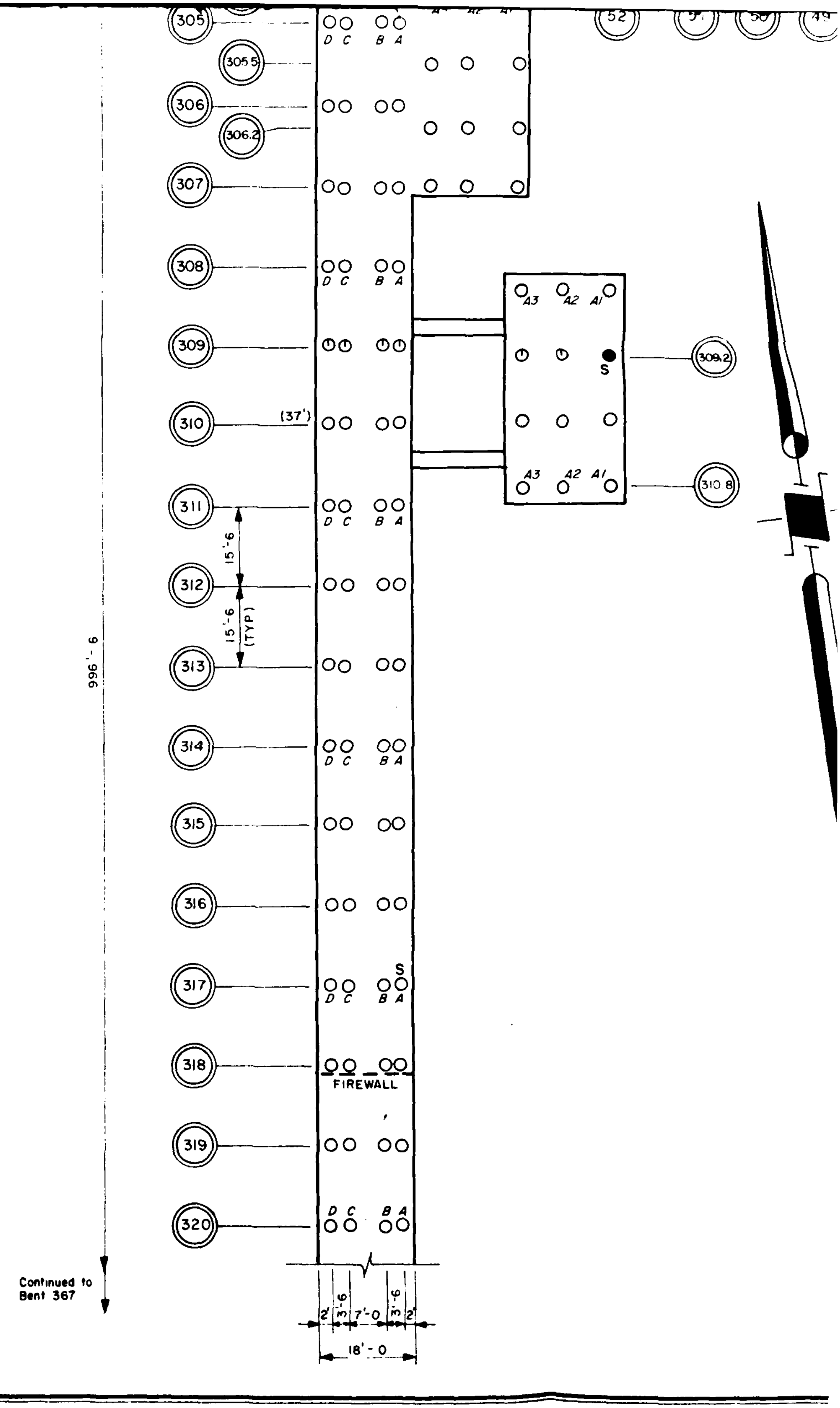
INSPECTION LEVEL DESIGNATIONS

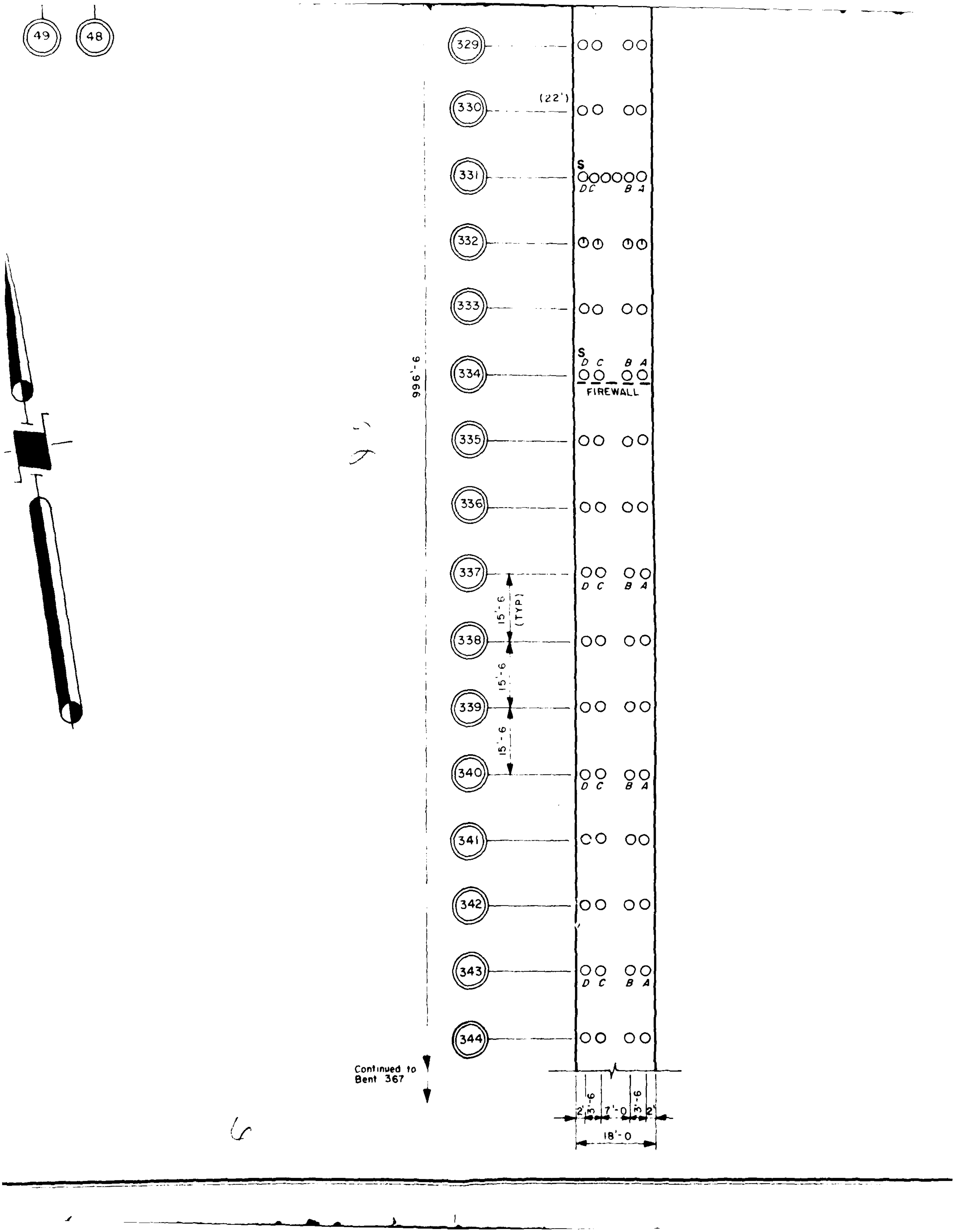
LEVEL I - all perimeter piles from bents 301 to 365 on the west side and 302.4 to 365 on the east side
- all piles in bents 301, 304, 307, 310, 315, 320, 325, 330, 335, 340, 345, 350, 355 and 360

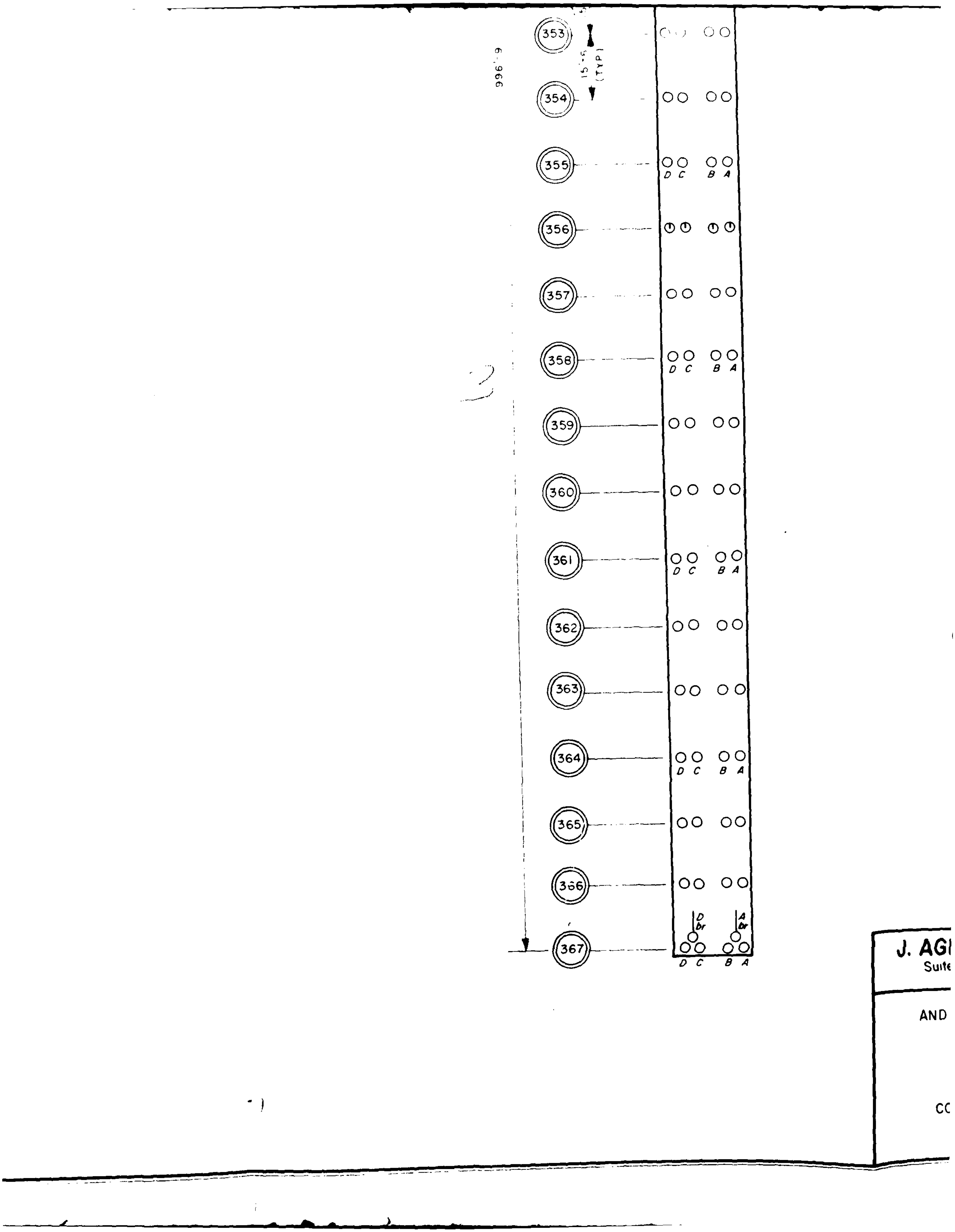
S SIGNIFICANTLY DAMAGED PILE

LEVEL III - inspected piles indicated by;

- 100% REMAINING CROSS-SECTIONAL AREA
- 75% REMAINING CROSS-SECTIONAL AREA
- 50% REMAINING CROSS-SECTIONAL AREA
- 25% REMAINING CROSS-SECTIONAL AREA
- 0-25% REMAINING CROSS-SECTIONAL AREA

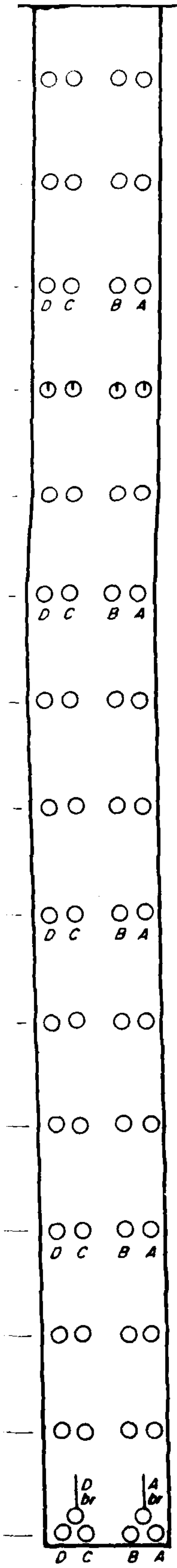

305
305.5
306
306.2
307
308
309
309.2
310
(37')
310.8
311
312
313
314
315
316
317
318
FIREWALL
319
320
D C B A
A3 A2 A1
S
15'-6
15'-6 (TYP)
996'-9
Continued to Bent 367
2'
3'-6
7'-0
18'-0
52
50
49


49
48
329
330
(22')
331
S
D C B A
332
333
334
S
D C B A
FIREWALL
335
336
337
D C B A
15'-6 (TYP)
338
15'-6
339
15'-6
340
D C B A
341
342
343
D C B A
344
996'-6
Continued to Bent 367
2'
3'-6
7'-0
3'-6
2'
18'-0



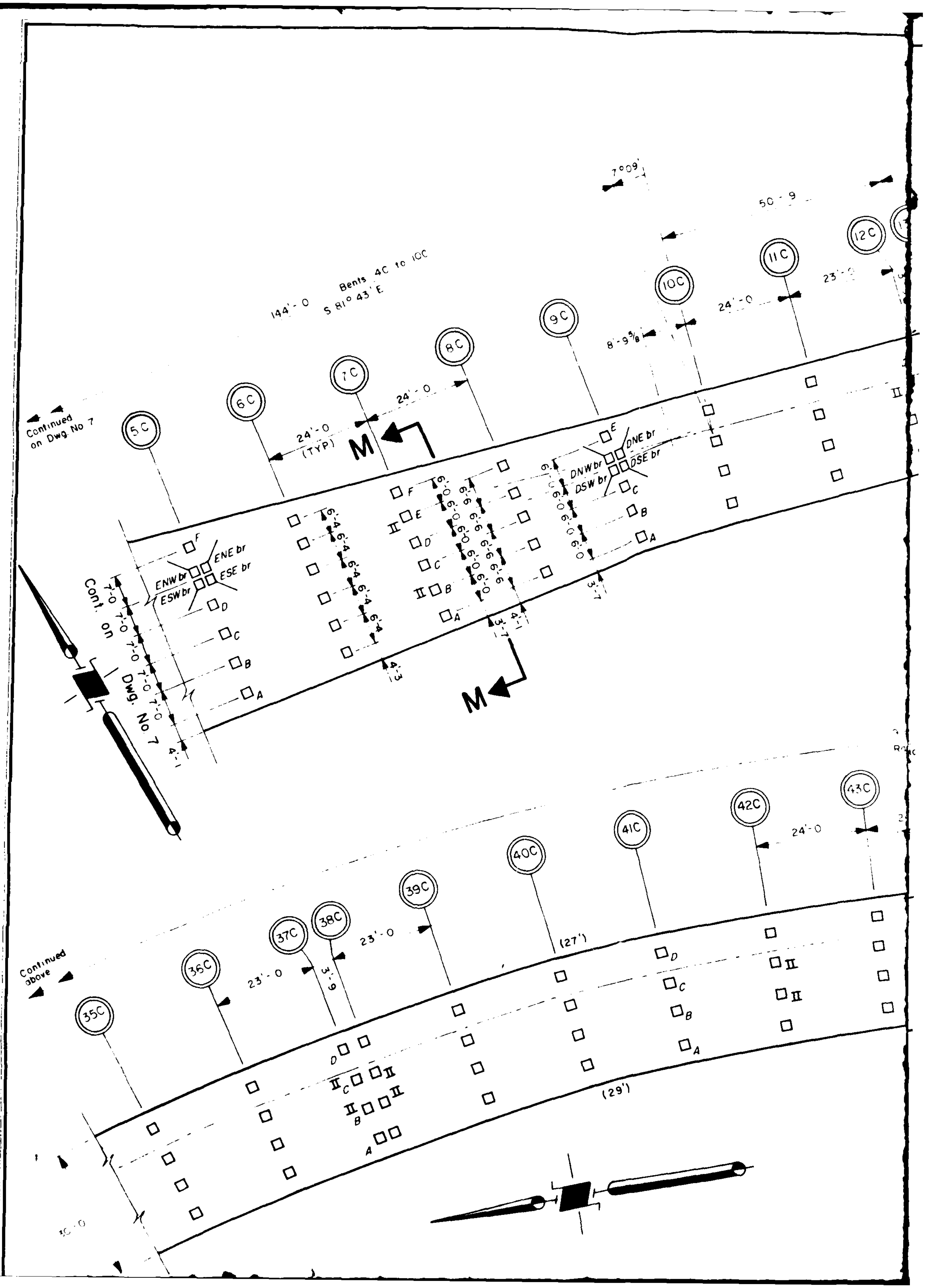
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
(TYP)
D C B A
D br
A br
J. AG
Suit
AND
CC

100% REMAINING CROSS-SECTIONAL AREA
75% REMAINING CROSS-SECTIONAL AREA
50% REMAINING CROSS-SECTIONAL AREA
25% REMAINING CROSS-SECTIONAL AREA
0-25% REMAINING CROSS-SECTIONAL AREA

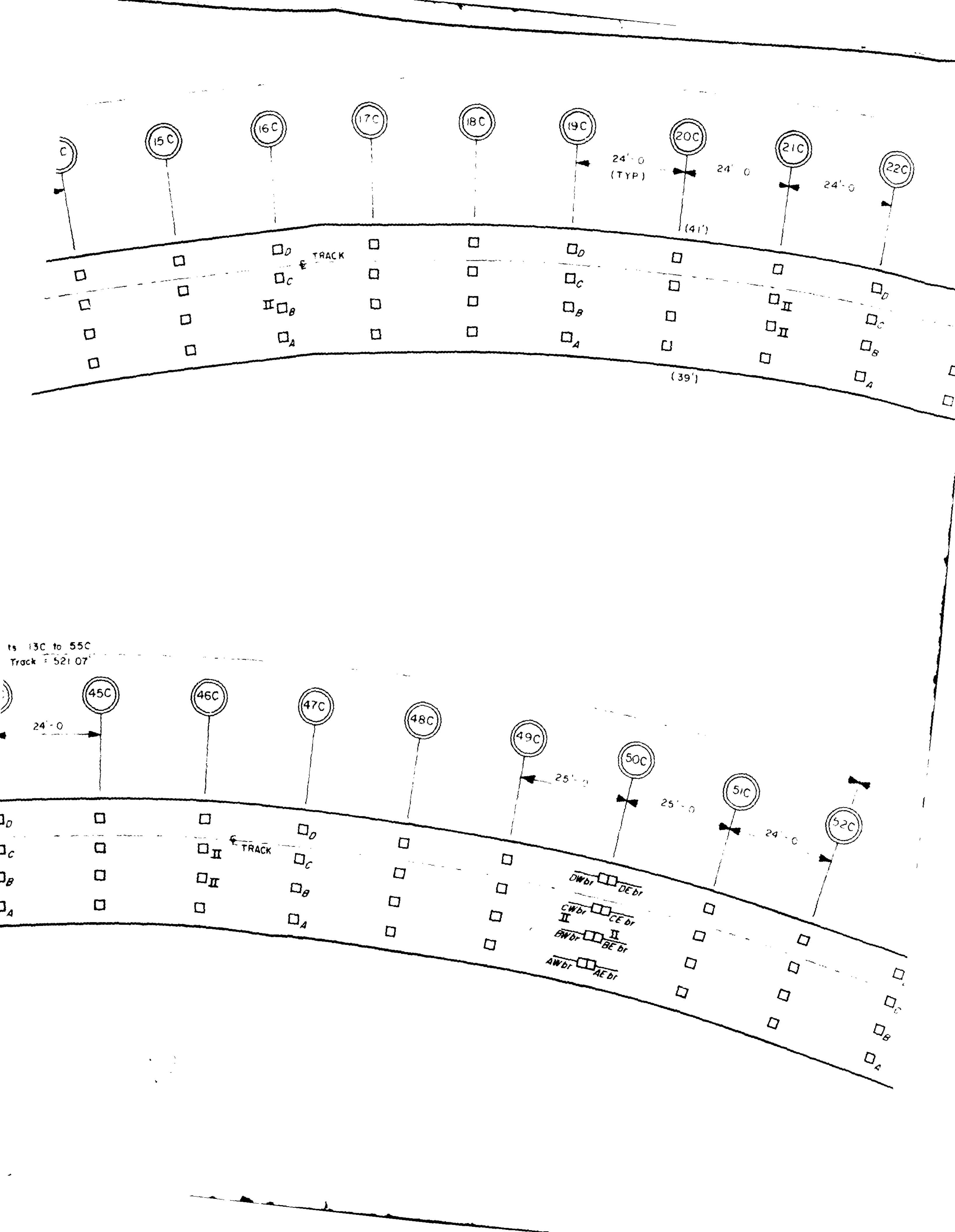


4

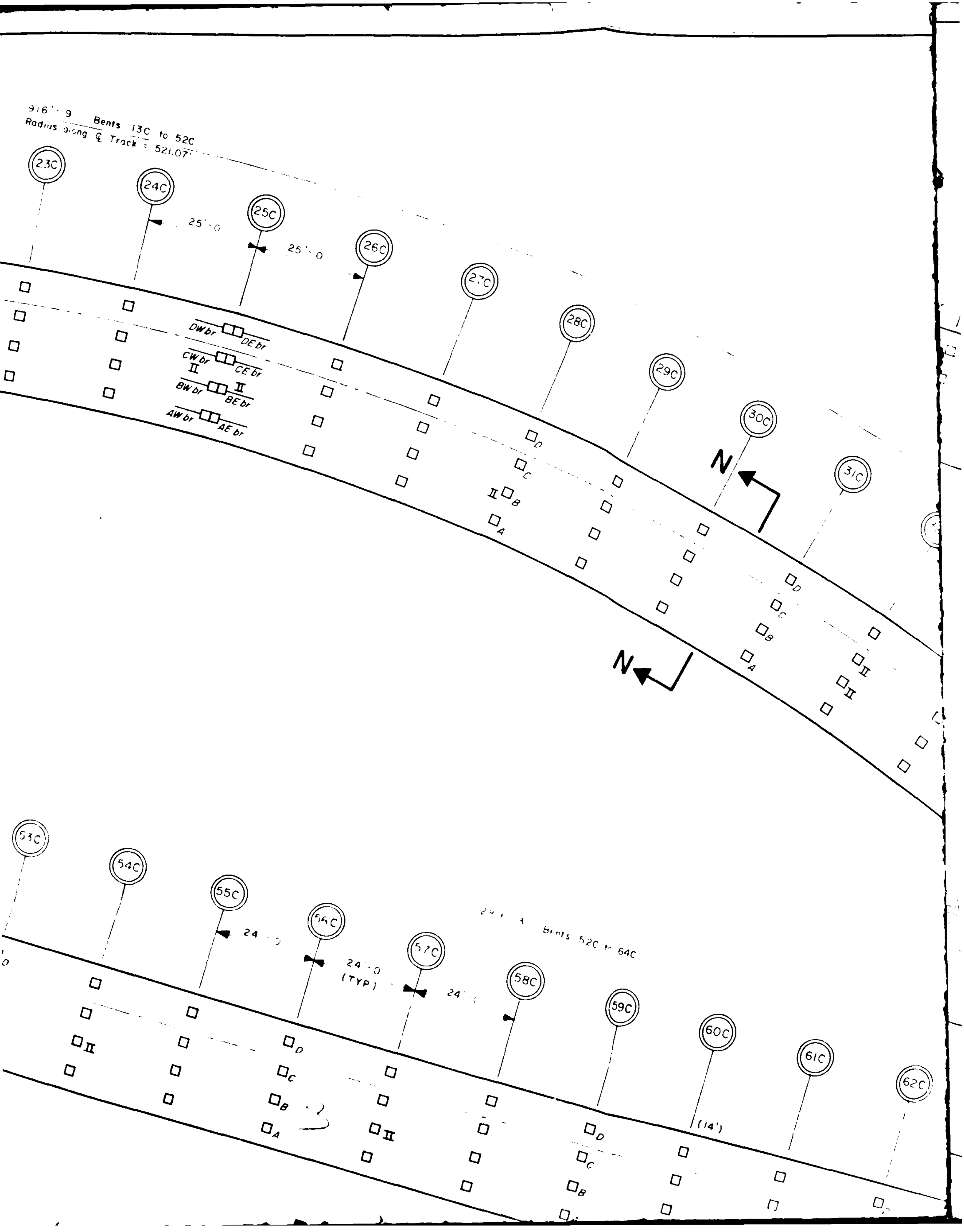
J. AGI & ASSOCIATES CO. LTD. Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE 1" = 20' DRAWN F.P.
PLAN SHOWING LOCATION AND CONDITION OF INSPECTED PILING IN PIER 4, ACCESS TRESTLE U.S. NAVAL WEAPONS STATION CONCORD, CALIFORNIA CHES DIV. NAV FAC ENG COM REPORT No. FPO-1-83-(19) CONTRACT No. N62477-81-C-0498 TASK 2 **DWG. No. 9**	CHECKED J.P. APPROVED XIE DATE JUNE 7, 1983 PROJECT No **83-1/3-2-100**



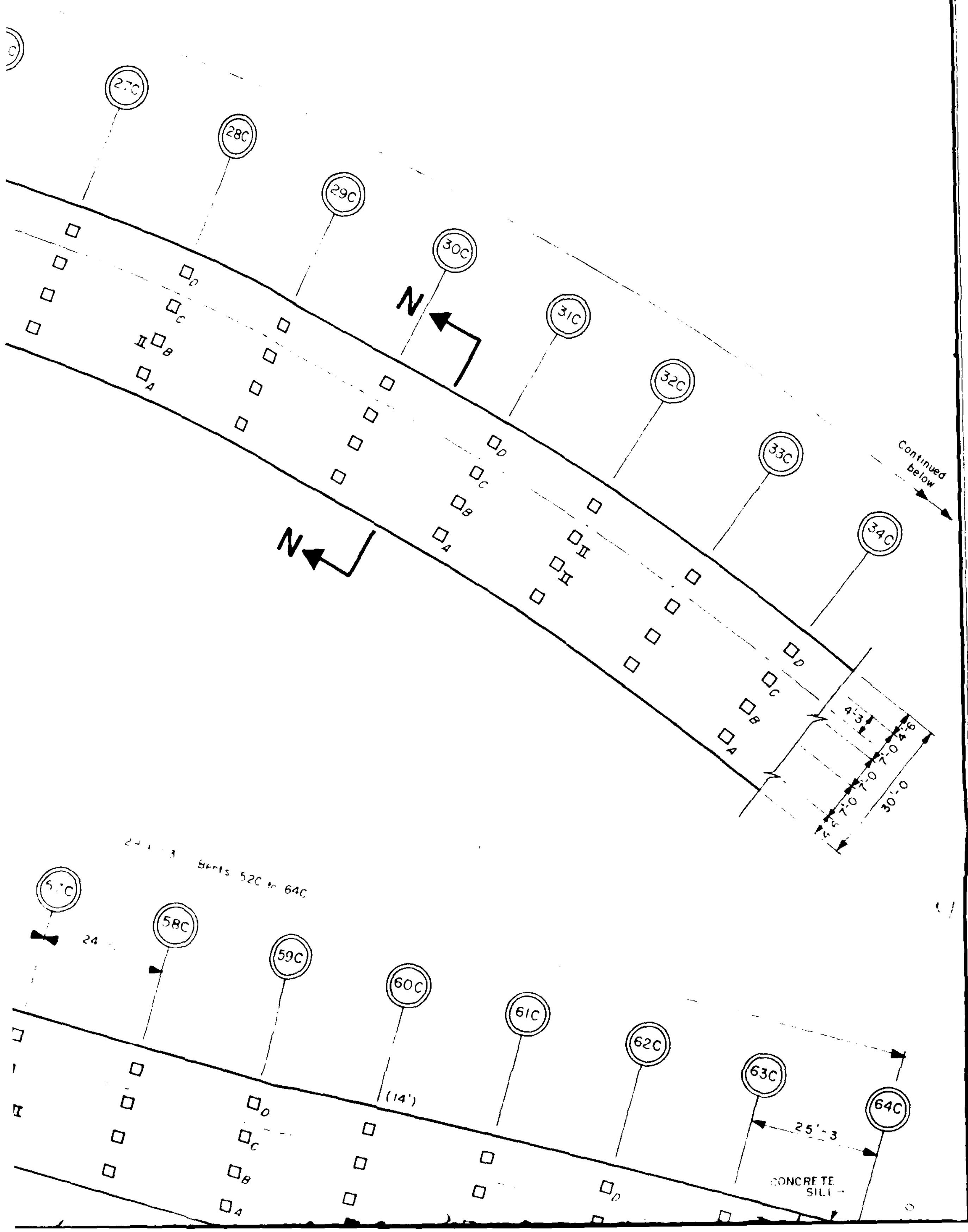
Continued on Dwg. No 7
144'-0
Bents 4C to 10C
S 81° 43' E
7°09'
50'-9
5C
6C
7C
8C
9C
10C
11C
12C
24'-0 (TYP)
24'-0
23'-0
8'-9 5/8
M
M
ENE br
ESE br
ENW br
ESW br
DNE br
DSE br
DNW br
DSW br
Cont. on Dwg. No. 7
Continued above
35C
36C
37C
38C
39C
40C
41C
42C
43C
23'-0
3'-9
(27')
(29')

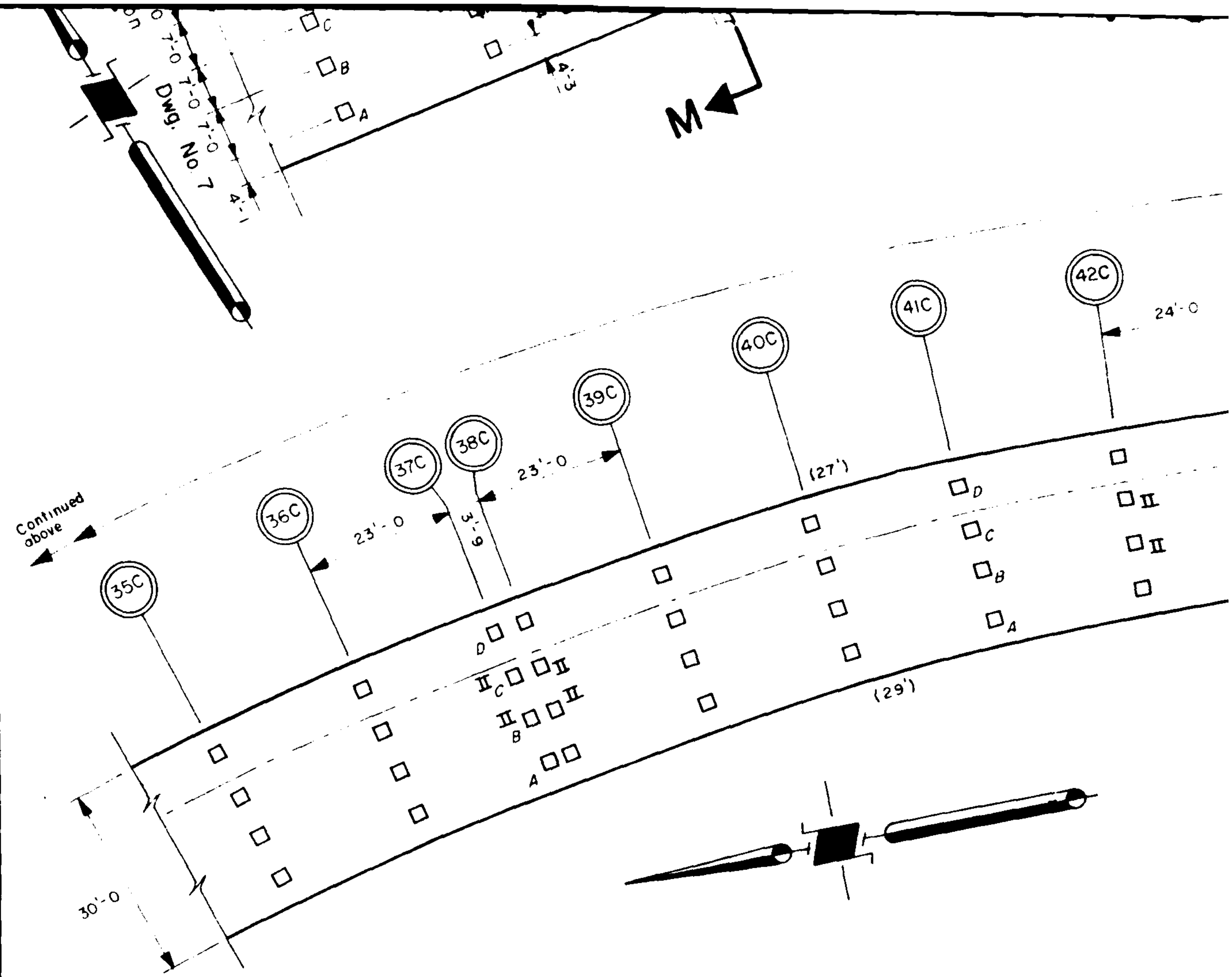


15C
16C
17C
18C
19C
20C
21C
22C
24'-0 (TYP)
24'-0
24'-0
(41')
(39')
℄ TRACK
ts 13C to 55C
Track = 521 07'
45C
46C
47C
48C
49C
50C
51C
52C
24'-0
25'-0
25'-0
24'-0
℄ TRACK
DWbr
DEbr
CWbr
CEbr
BWbr
BEbr
AWbr
AEbr

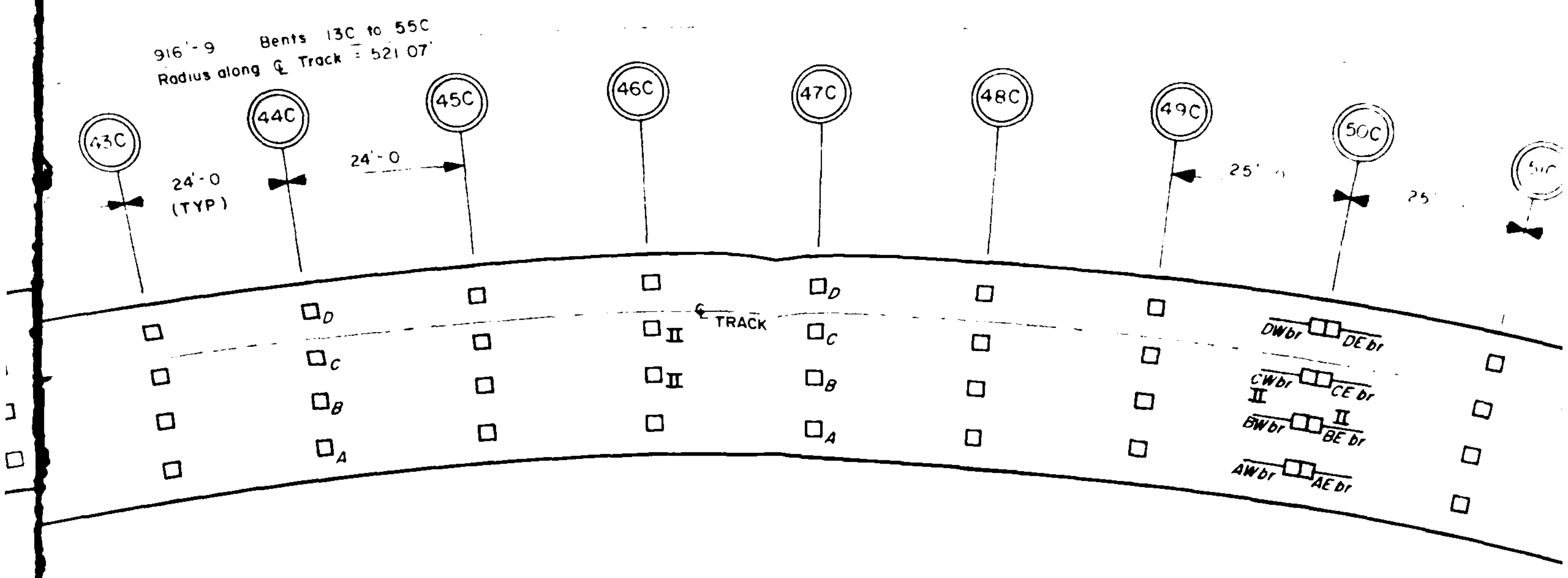


916'-9 Bents 13C to 52C
Radius along ℄ Track = 521.07'
23C
24C
25C
26C
27C
28C
29C
30C
31C
25'-0
25'-0
DW br
DE br
CW br
CE br
II
BW br
BE br
II
AW br
AE br
D
C
B
A
II
N
N
53C
54C
55C
56C
57C
58C
59C
60C
61C
62C
Bents 52C to 64C
24'-0
24'-0
(TYP)
(14')


27C
28C
29C
30C
31C
32C
33C
34C
N
N
Continued below
4'-3
4'-6
7'-0
7'-0
7'-0
30'-0
Bents 52C to 64C
57C
58C
59C
60C
61C
62C
63C
64C
24
(14')
25'-3
CONCRETE SILL



Dwg. No 7
M
Continued above
35C
36C
37C
38C
39C
40C
41C
42C
23'-0
23'-0
3'-9
24'-0
(27')
(29')
30'-0



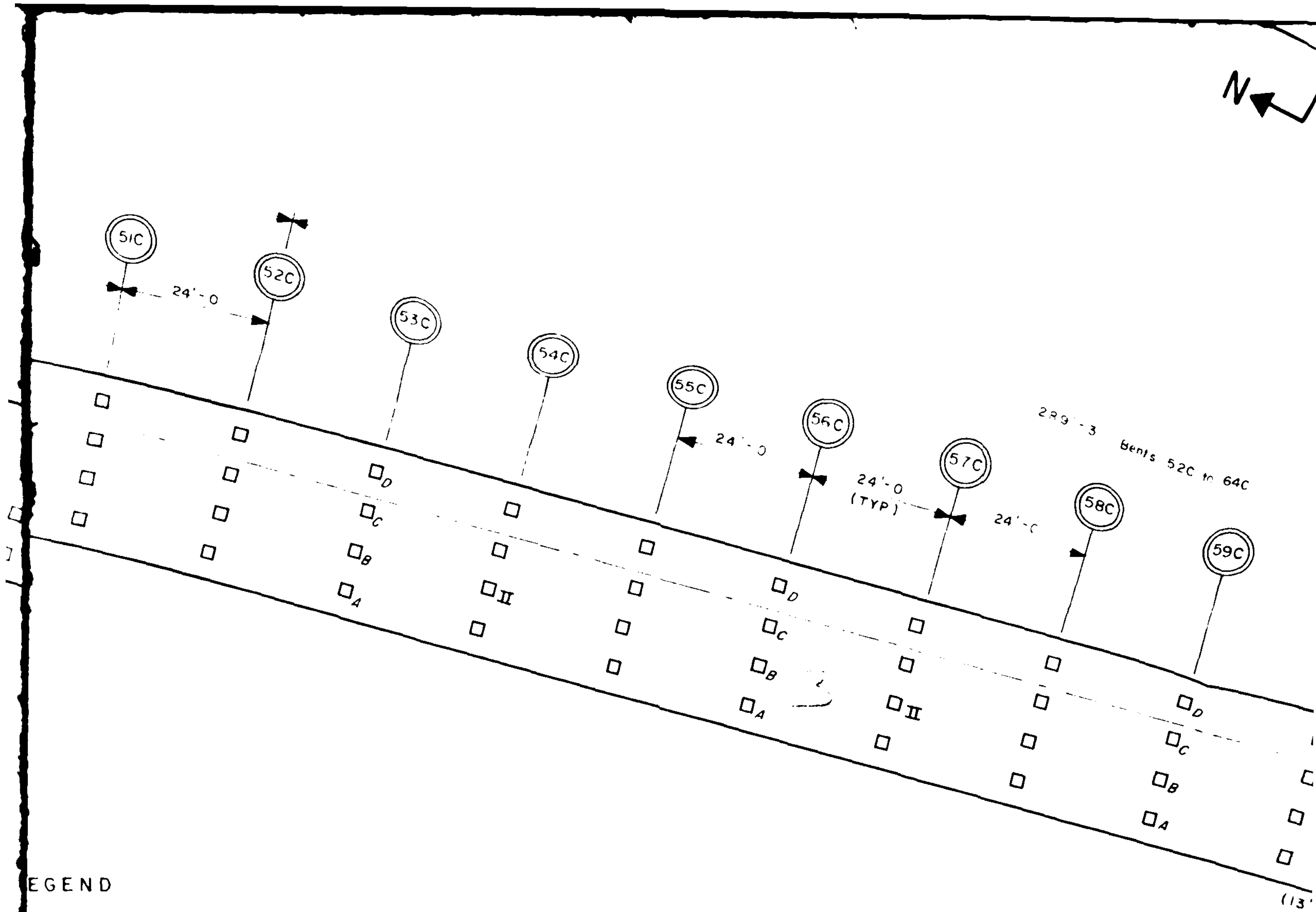
LEGEND

(49C)	BENT No.
A	PILE ROW DESIGNAT
□	18"x 18" OR 20"x 20" C
□——	18"x 18" OR 20"x 20" C
m	PILE MISSING
NB	PILE NOT BEARING
(27')	PILE LENGTH, CAP

INSPECTION LEVEL DESIGN

LEVEL I - all perimeter
- all piles in b
S SIGNIFICANT

LEVEL II - inspected pil
✱ SIGNIFICANT



EGEND

NT No

E ROW DESIGNATION

ETE 18" OR 20"x 20" CONCRETE PILE

ETE 18" OR 20"x 20" CONCRETE BATTER PILE

E MISSING

E NOT BEARING AT CAP

DULE LENGTH, CAP TO MUDLINE

NSLEVEL DESIGNATIONS

fr - all perimeter piles from bents 5C to 60C
- all piles in bents 11C, 14C, 20C, 29C, 36C, 39C, 49C and 60C

MA S SIGNIFICANTLY DAMAGED PILE

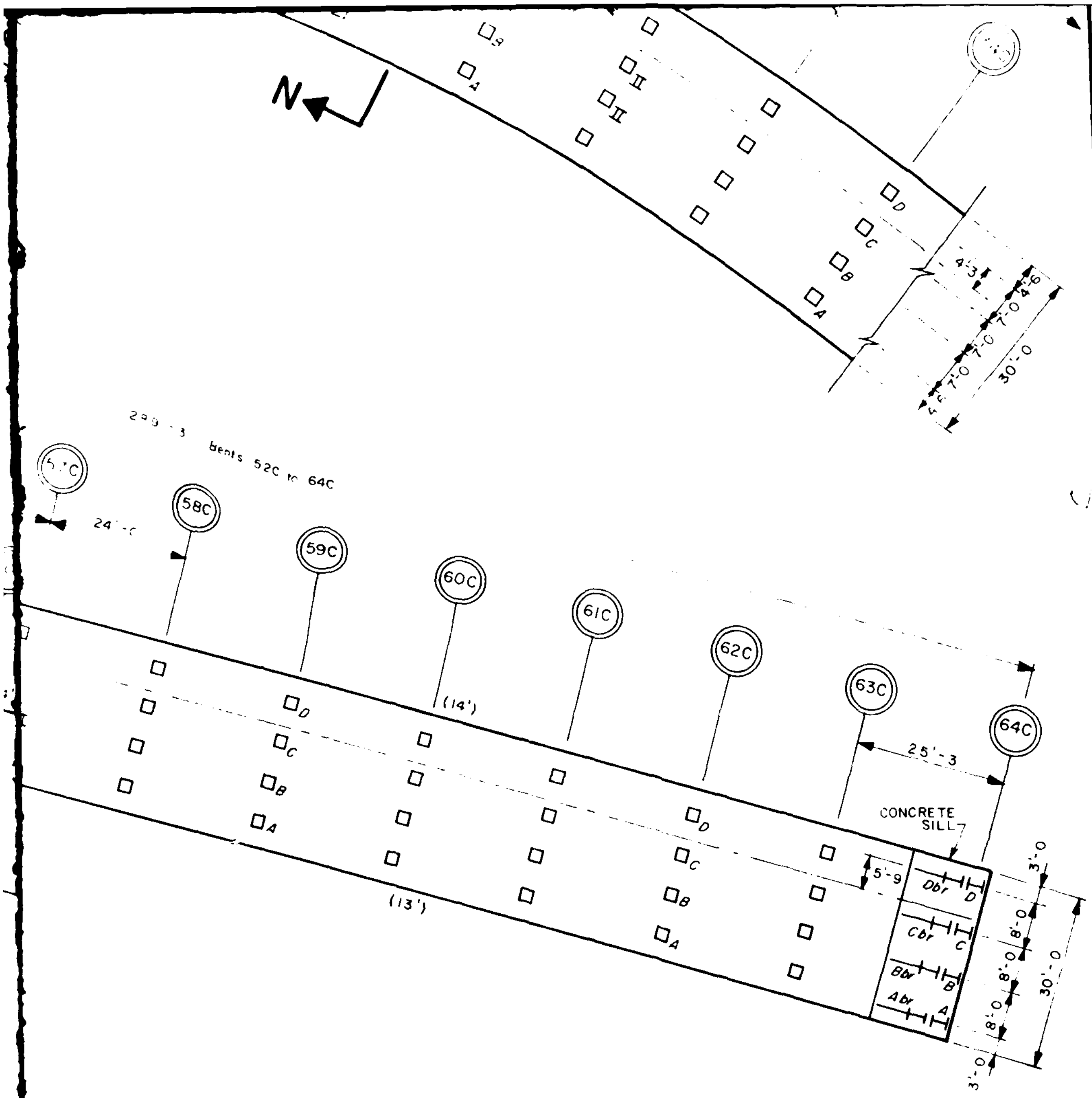
co - inspected piles indicated by (II)

AG * SIGNIFICANTLY DAMAGED PILE

Note

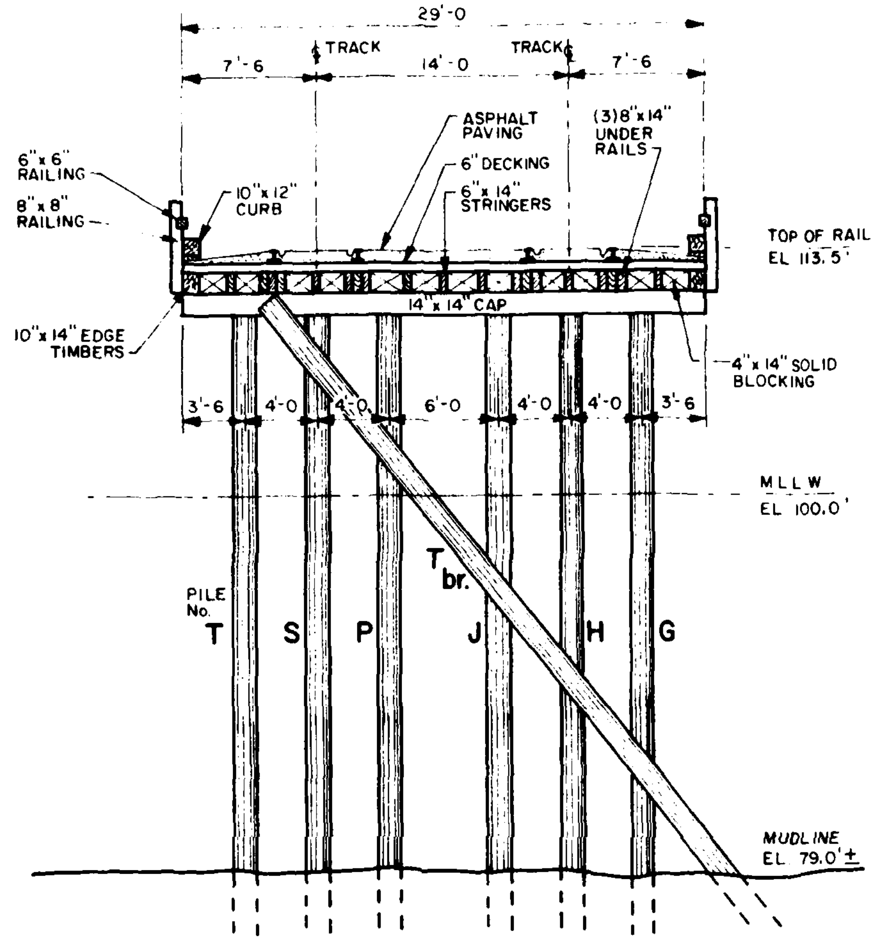
J. A
S

AN

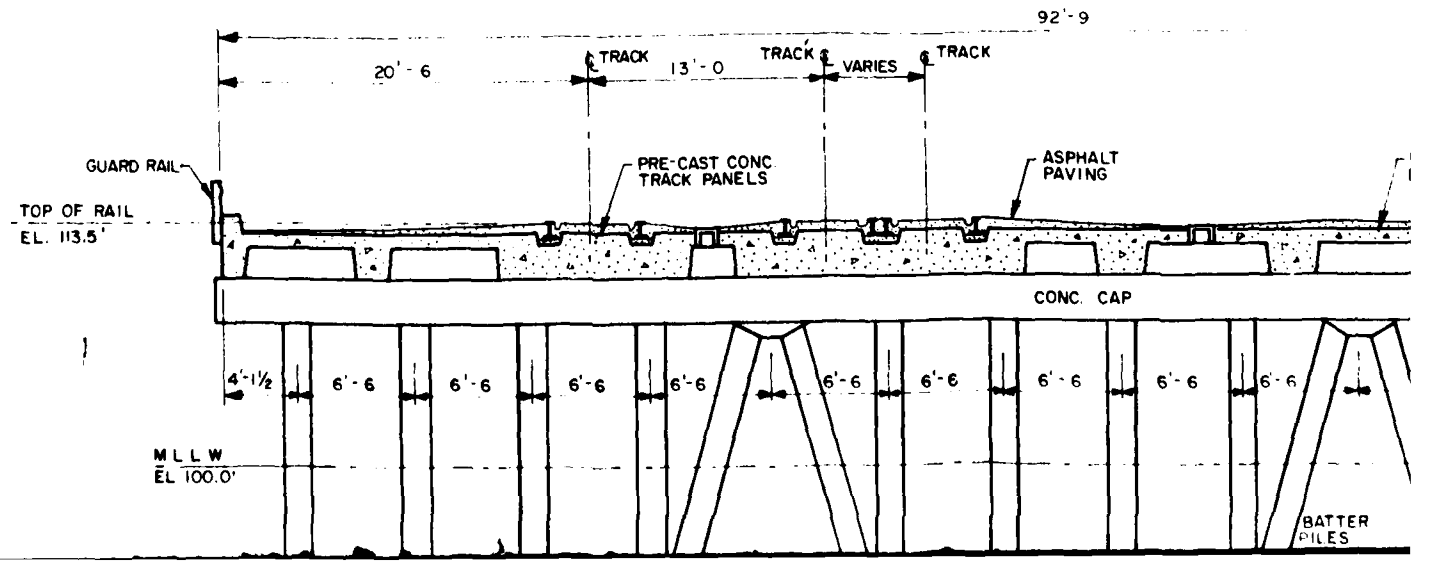


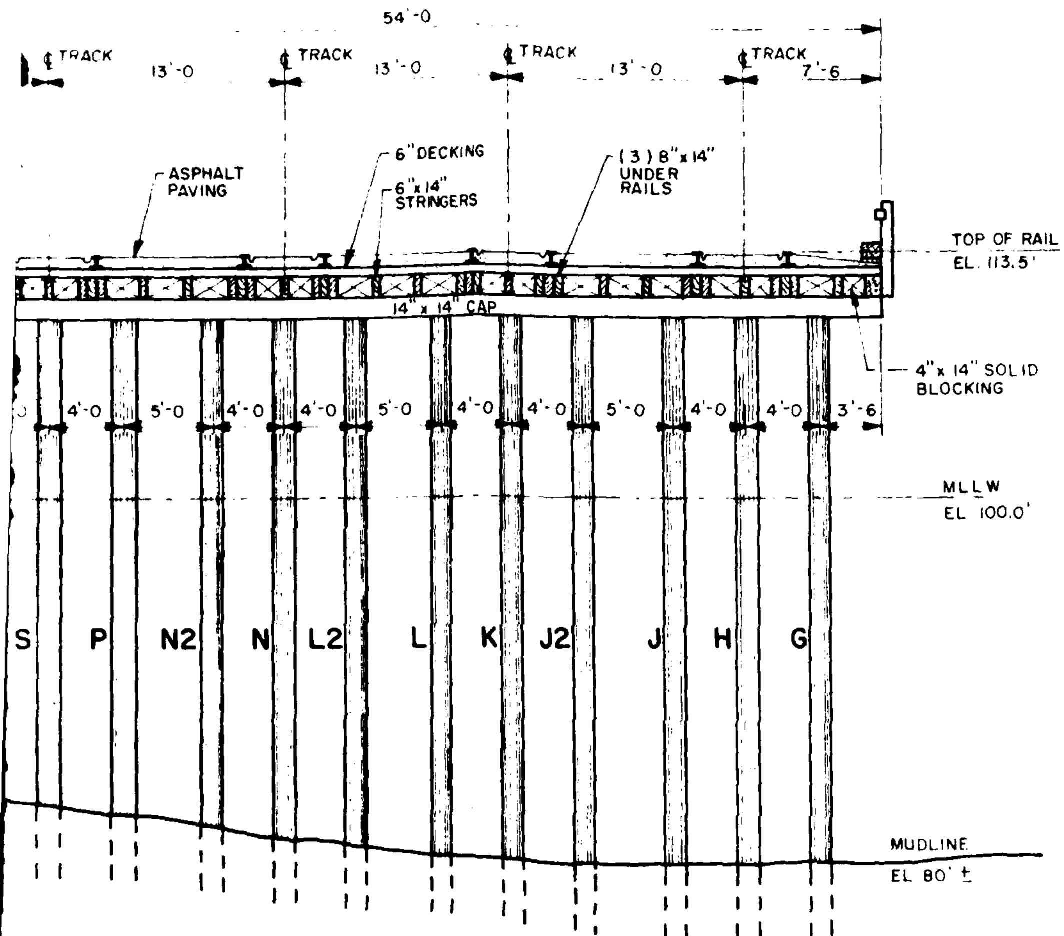
Note: 20" concrete piles to Bent 39C
18" concrete piles in Bents 40C to 64C

J. AGI & ASSOCIATES CO. LTD. Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE 1" = 20'
	DRAWN FP
PLAN SHOWING LOCATION AND CONDITION OF INSPECTED PILING IN PIER 4, CONCRETE TRESTLE U.S. NAVAL WEAPONS STATION CONCORD, CALIFORNIA CHES DIV NAV FAC ENG COM REPORT No. FPO-1-83-(19) CONTRACT No. N62477-81-C-0498 TASK 2 **DWG. No. 10**	CHECKED J.P.
	APPROVED X/E
	DATE JUNE 7, 1983.
	PROJECT No **83-1/3-2-100**

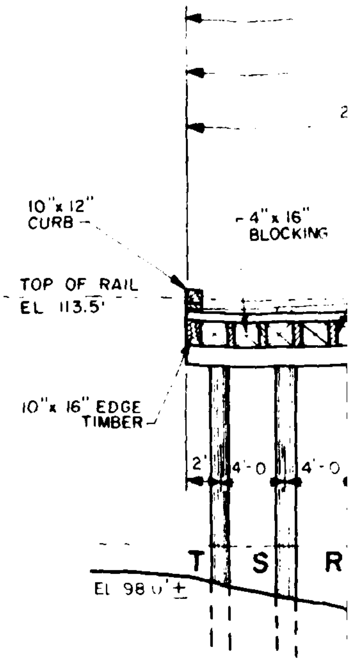


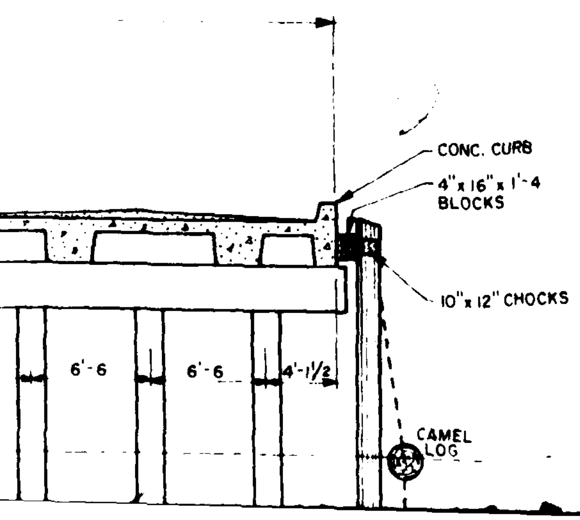
SECTION H-H
APPROACH TRESTLE
BENT 166

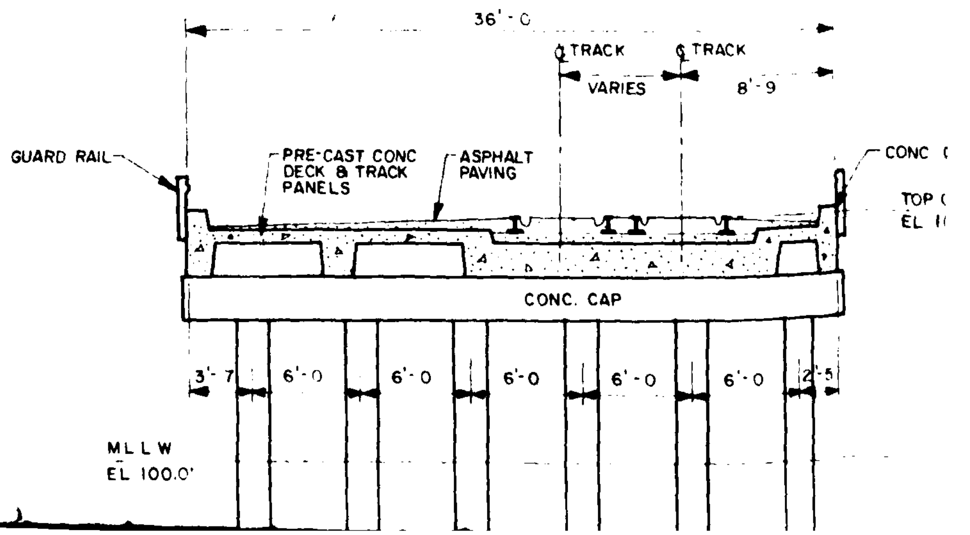


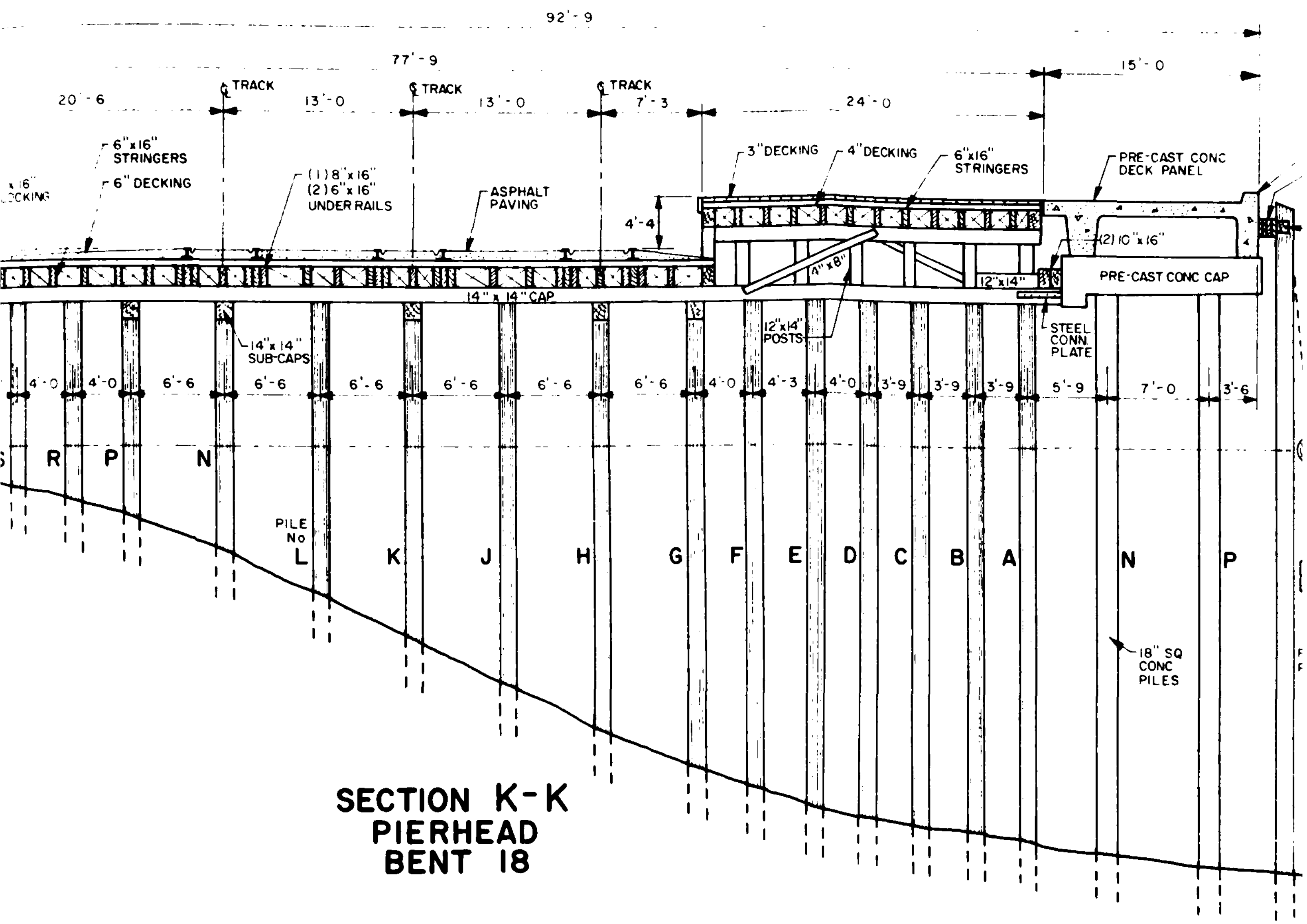


SECTION J-J
APPROACH TRESTLE
BENT 109

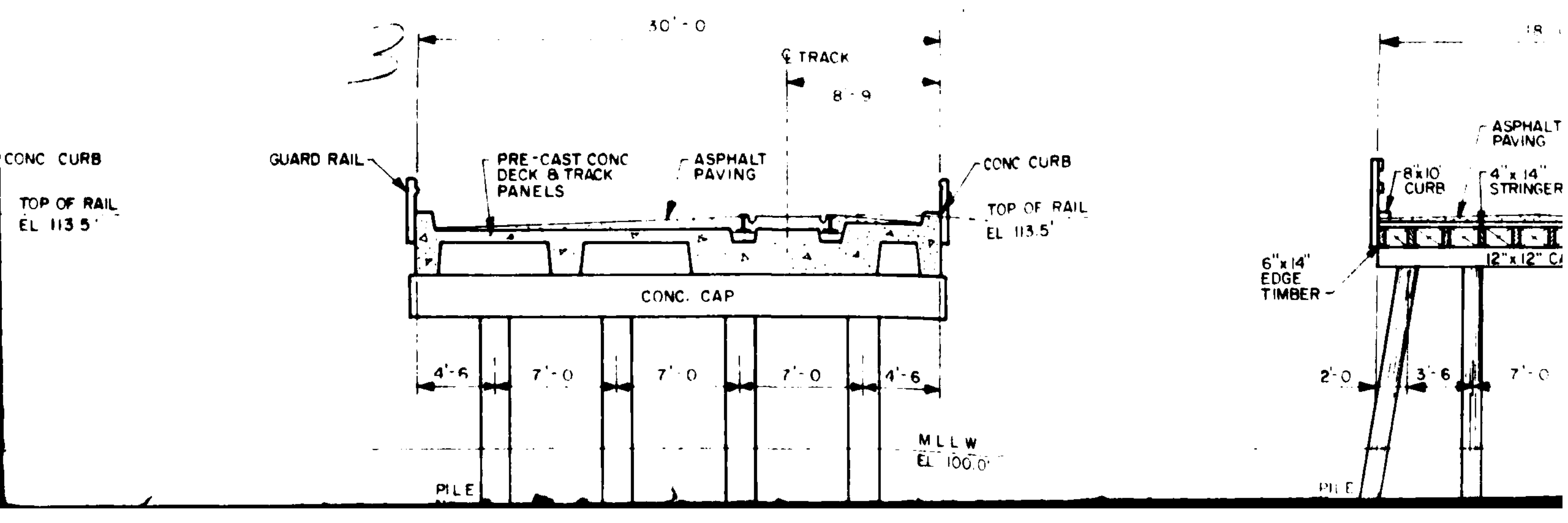


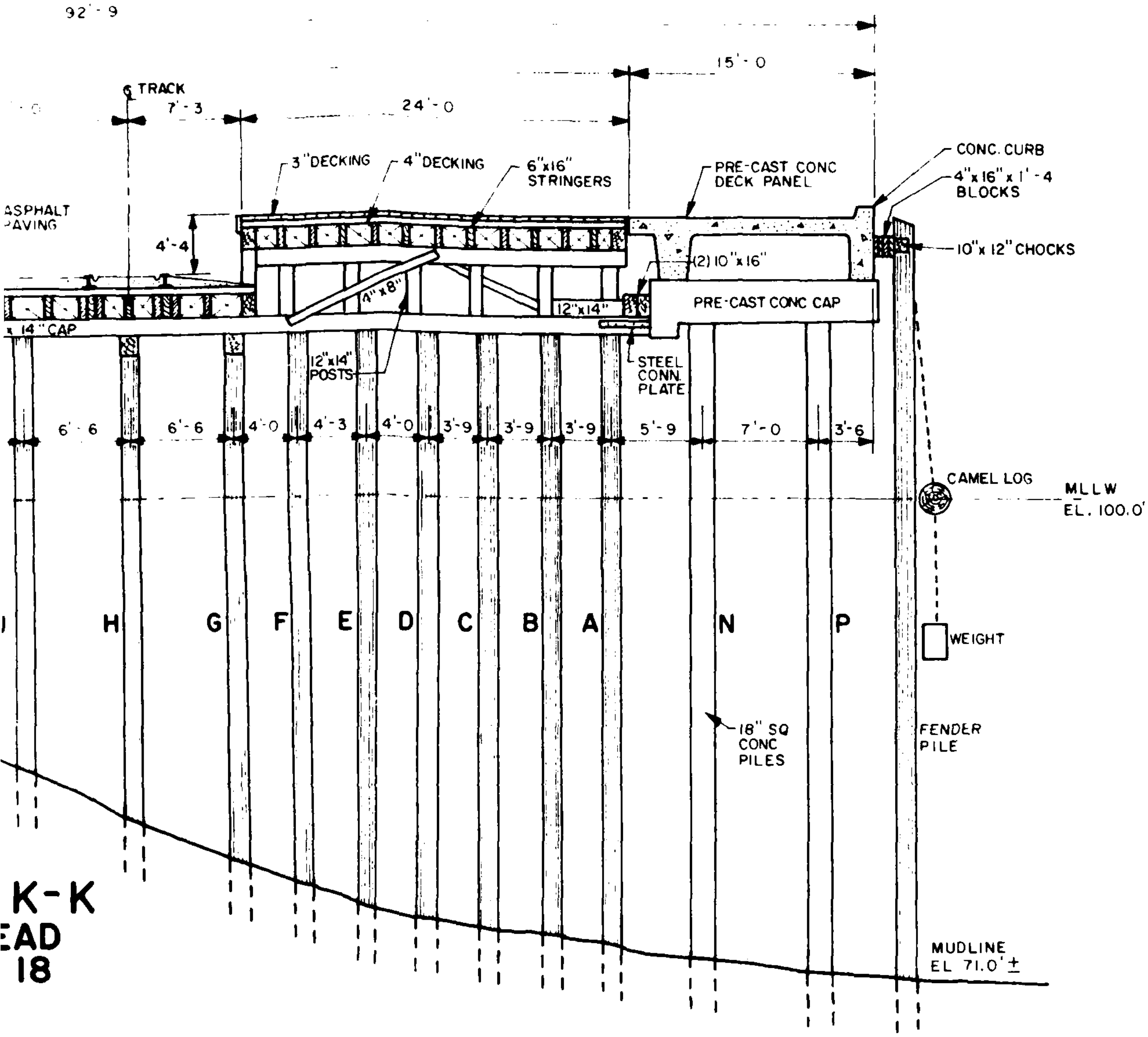
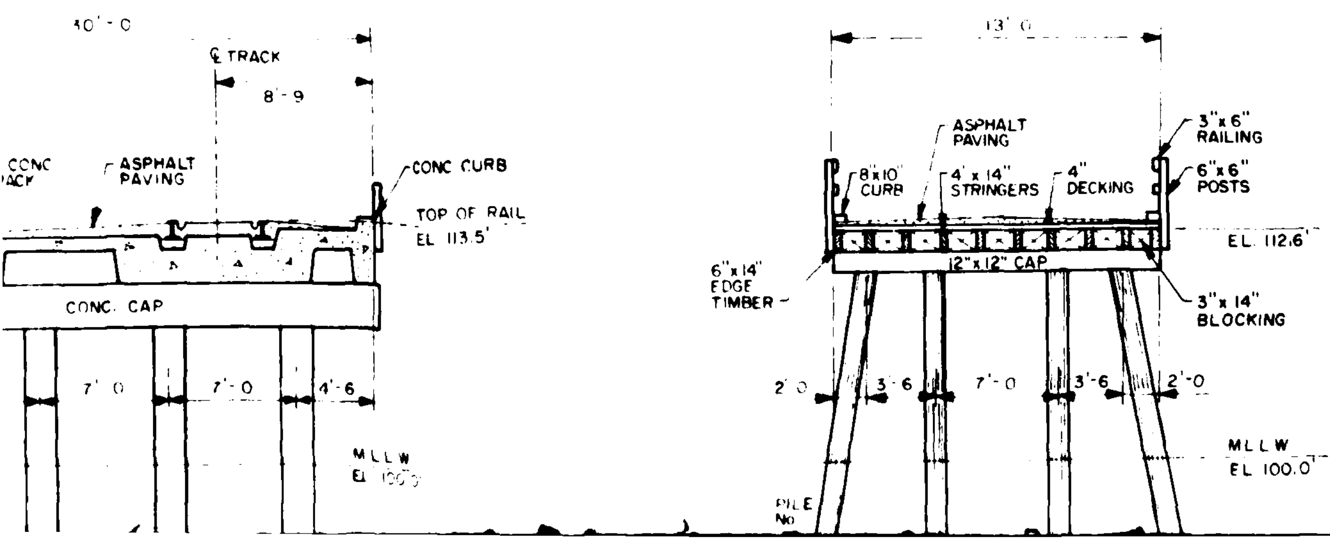


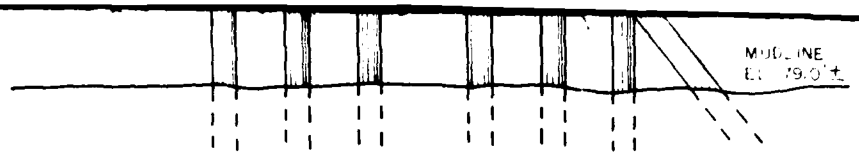




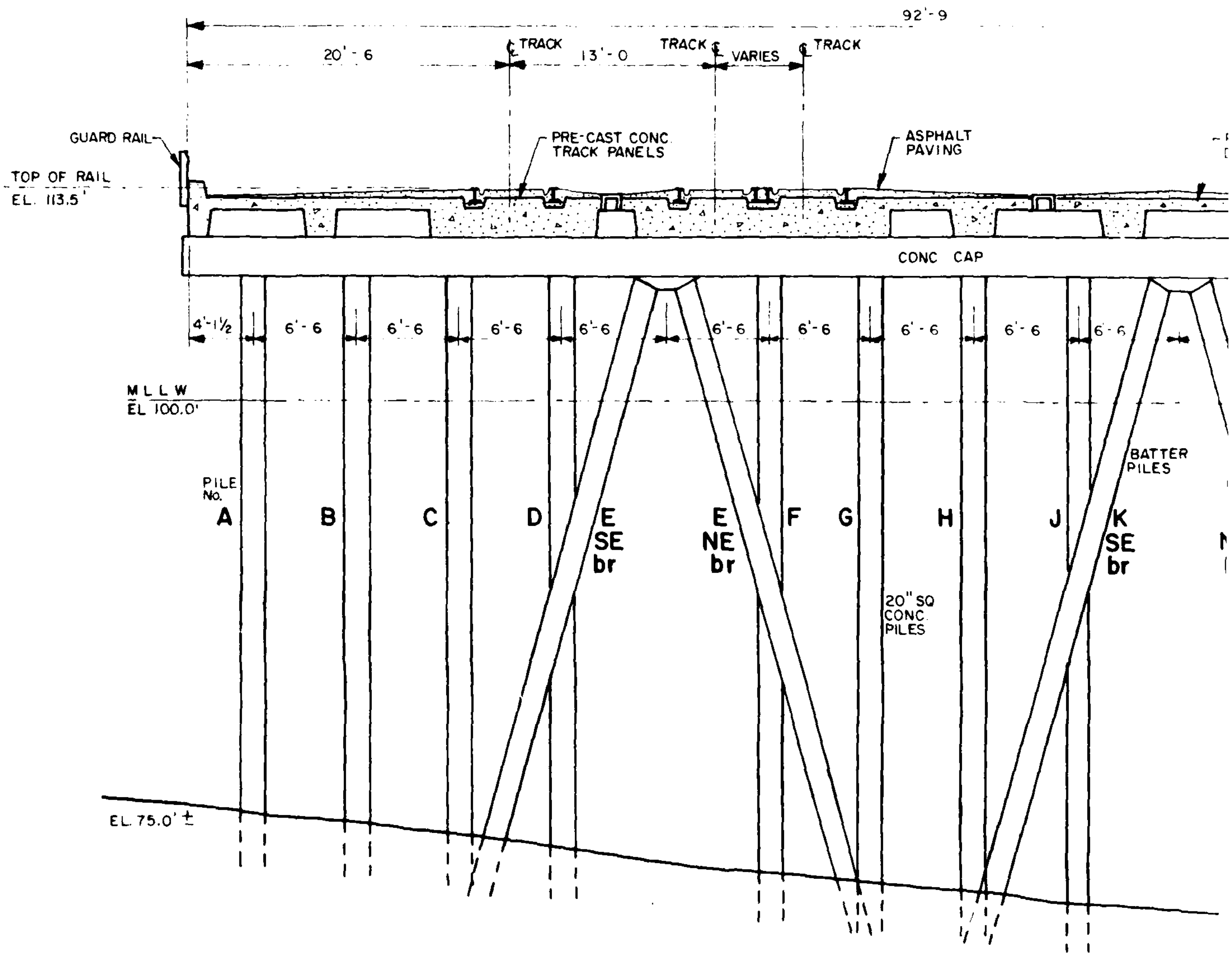
SECTION K-K
PIERHEAD
BENT 18



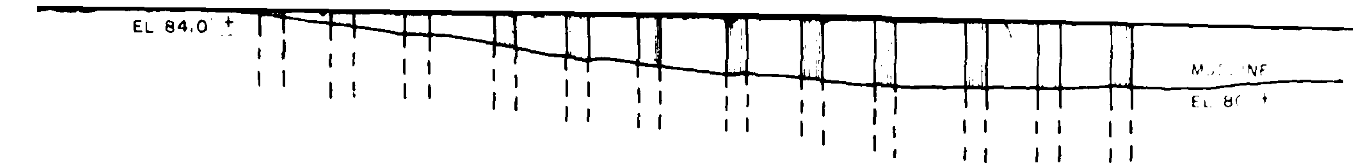

92'-9
℄ TRACK
7'-3
24'-0
15'-0
3"DECKING
4"DECKING
6"x16" STRINGERS
PRE-CAST CONC DECK PANEL
CONC. CURB
4"x16"x1'-4 BLOCKS
10"x12" CHOCKS
ASPHALT PAVING
4'-4
(2) 10"x16"
4"x8"
12"x14"
PRE-CAST CONC CAP
x 14" CAP
12"x14" POSTS
STEEL CONN. PLATE
6'-6
6'-6
4'-0
4'-3
4'-0
3'-9
3'-9
3'-9
5'-9
7'-0
3'-6
CAMEL LOG
MLLW EL. 100.0'
H
G
F
E
D
C
B
A
N
P
WEIGHT
18" SQ CONC PILES
FENDER PILE
K-K
EAD
18
MUDLINE EL 71.0'±

40'-0
℄ TRACK
8'-9
CONC
ASPHALT PAVING
CONC CURB
TOP OF RAIL EL 113.5'
CONC. CAP
7'-0
7'-0
4'-6
MLLW
13'-0
ASPHALT PAVING
3"x6" RAILING
8"x10" CURB
4"x14" STRINGERS
4" DECKING
6"x6" POSTS
EL 112.6'
12"x12" CAP
6"x14" EDGE TIMBER
3"x14" BLOCKING
2'-0
3'-6
7'-0
3'-6
2'-0
MLLW EL 100.0'
PILE No



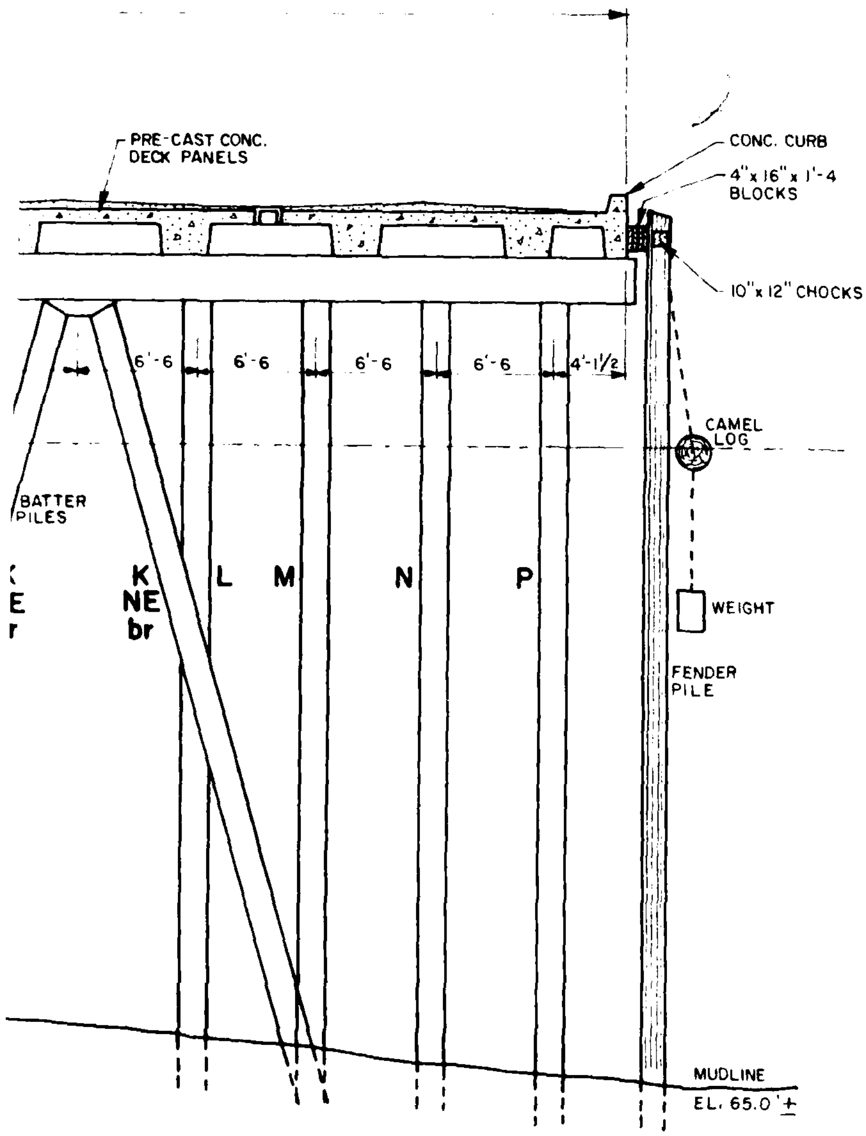
SECTION H-H
APPROACH TRESTLE
BENT 166

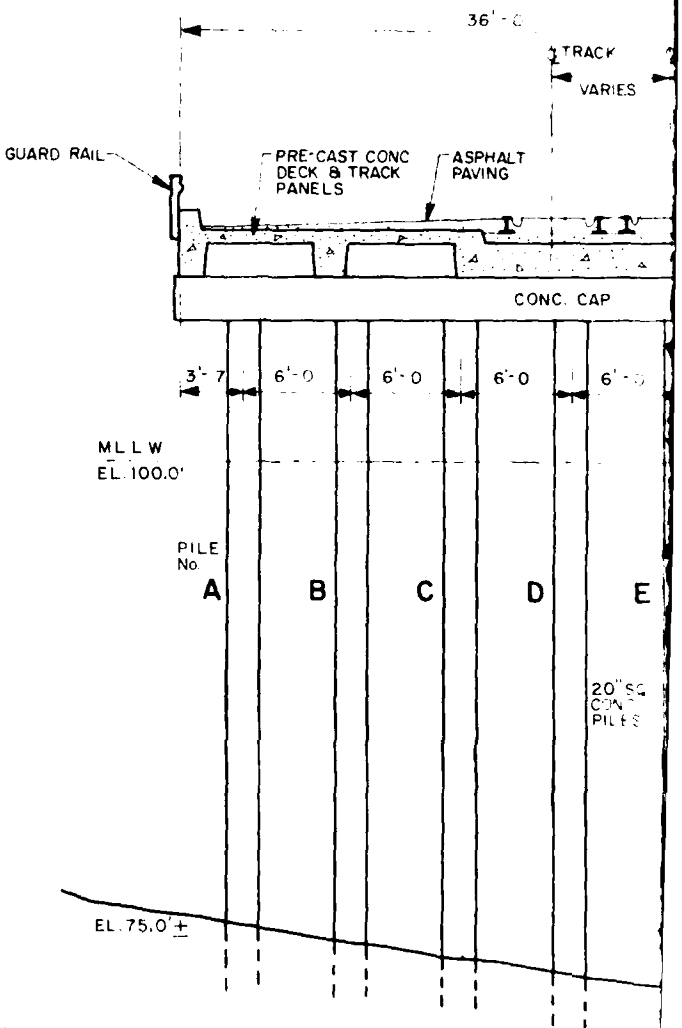


SECTION L-L
PIERHEAD
CONCRETE EXTENSION
BENT 3C



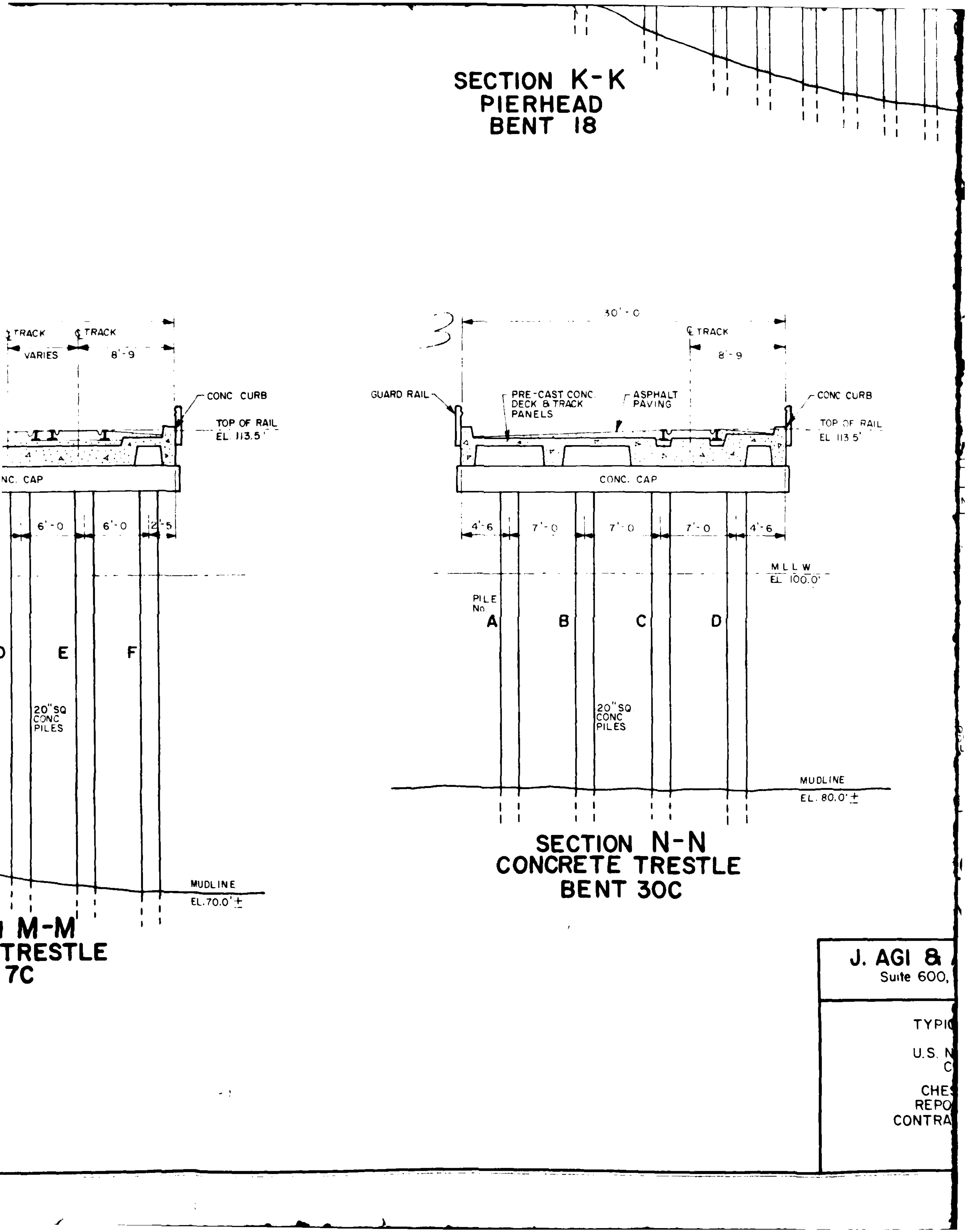
SECTION J-J
APPROACH TRESTLE
BENT 109

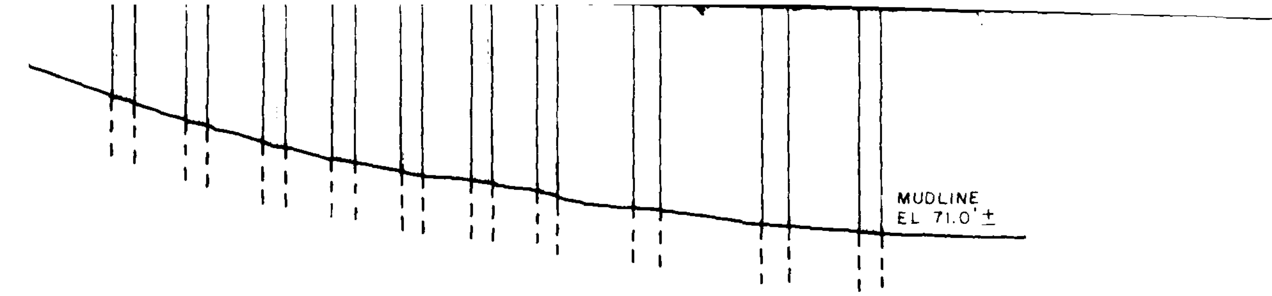


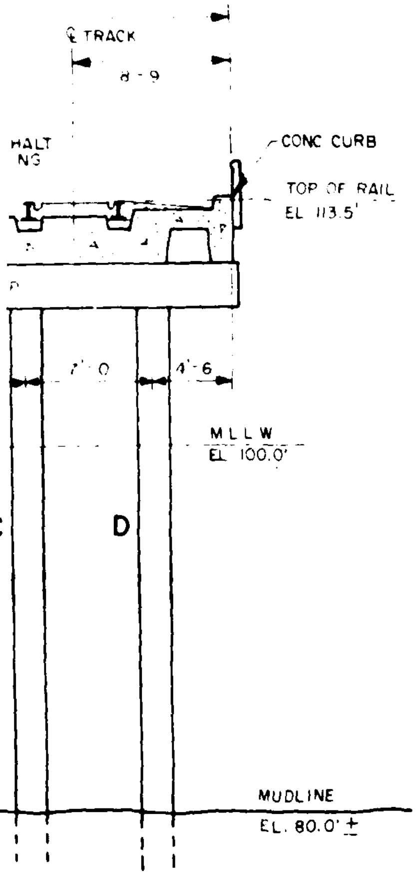


SECTION M-M
CONCRETE TREST
BENT 7C

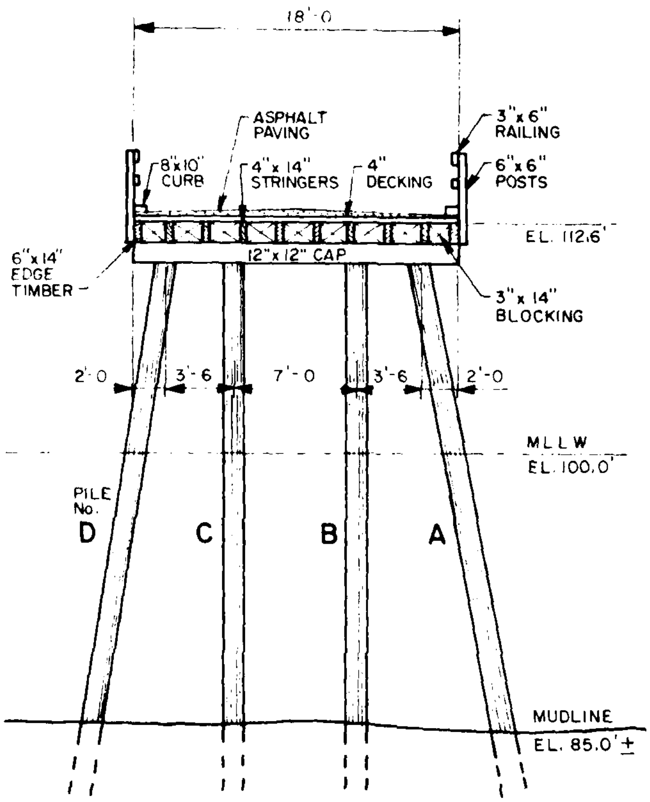
6


SECTION K-K
PIERHEAD
BENT 18
℄ TRACK
℄ TRACK
VARIES
8'-9
CONC CURB
TOP OF RAIL
EL 113.5'
NC. CAP
6'-0
6'-0
2'-5
E
F
20"SQ
CONC
PILES
MUDLINE
EL.70.0'±
M-M
TRESTLE
7C
30'-0
℄ TRACK
8'-9
GUARD RAIL
PRE-CAST CONC.
DECK & TRACK
PANELS
ASPHALT
PAVING
CONC CURB
TOP OF RAIL
EL 113.5'
CONC. CAP
4'-6
7'-0
7'-0
7'-0
4'-6
MLLW
EL 100.0'
PILE
No
A
B
C
D
20"SQ
CONC
PILES
MUDLINE
EL. 80.0'±
SECTION N-N
CONCRETE TRESTLE
BENT 30C
J. AGI &
Suite 600,
TYPI
U.S. N
C
CHES
REPO
CONTRA





N-N
TRESTLE
30C



SECTION P-P
ACCESS TRESTLE
BENT 323

J. AGI & ASSOCIATES CO. LTD. Suite 600, 1414 Alaskan Way, Seattle, WA	SCALE 1/8" = 1'-0
	DRAWN F P
PLAN SHOWING TYPICAL SECTIONS THROUGH PIER 4 U.S. NAVAL WEAPONS STATION CONCORD, CALIFORNIA CHES DIV NAV FAC ENG COM REPORT No FPO-1-83-(19) CONTRACT No. N62477-81-C-0498 TASK 2 **DWG. No. 11**	CHECKED 7.P.
	APPROVED X/E
	DATE JUNE 7, 1983
	PROJECT No **83-1/3-2-100**

PHOTOGRAPH No. 18

Approachway Trestle - new piles and brace timbers added subsequent to ship impact damage of 1982. Also note typical timber superstructure.

PHOTOGRAPH No. 19

Concrete Trestle - typical confirguration of piles and caps. Note excellent condition of splash zones.

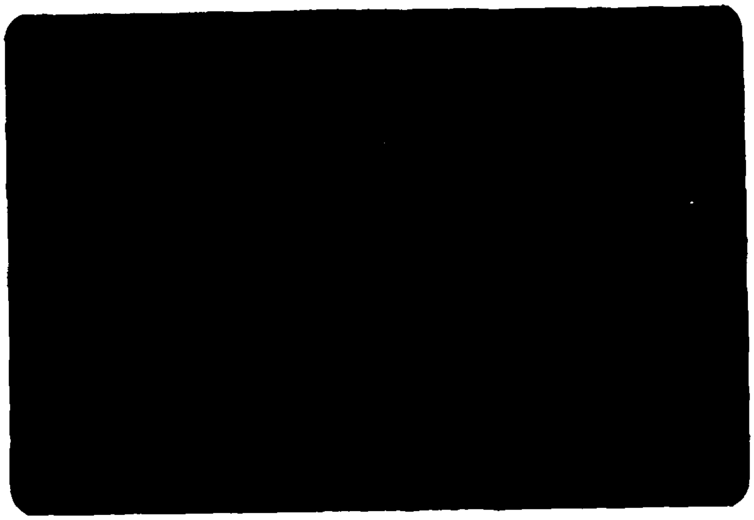
4.2.2 Observed Inspected Condition

The overall condition of Pier 4 is very good. As shown in photographs 20 and 21 and detailed in Tables 5 and 6, the majority of the timber piles are in excellent condition. The Level I inspection covered a total of 952 timber piles. Of the 952 piles inspected, 890 (94%) are undamaged; 50 (5%) piles have sustained marine borer attack or mechanical damage. At this time, this damage is of a minor or cosmetic nature and does not detract from the structural integrity of the piles. A total of 12 (1%) piles were found to have significant damage. Photographs 22 - 28 illustrate and identify several of the damaged piles found. As shown in these photographs, the damage has been caused by mechanical impact or abrasion, marine borer infestation and by fungal decay. The damaged piles were found throughout the structure and the damage on individual piles was found to range from the pile top through the splash zone to the intertidal zone.

As shown in photograph No.18, one section of the Approach Trestle in the vicinity of Bent 120 has recently sustained ship impact damage. This damage occurred at approximately mid 1982. Maintenance to repair the damaged section included the installation of several new creosote treated piles and the addition of both diagonal and horizontal timber braces. These repairs which were completed by the end of 1982 appear to be in good condition.

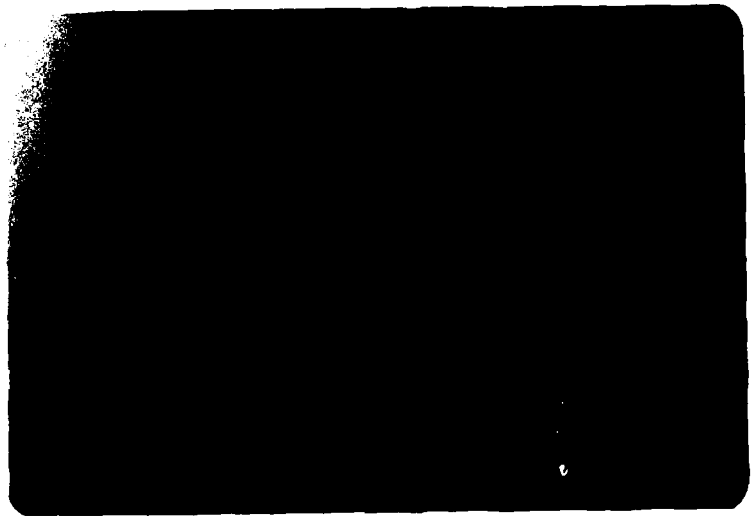
A total of 393 piles were subjected to detailed Level III ultrasonic testing and inspection. Of the 393 piles tested and inspected, 383 (97%) are undamaged and in excellent condition; 9 (2%) piles have sustained minor marine borer attack or mechanical damage and are rated at 90 - 100% of their original cross-sectional area, and 1 (1%) pile (photographs 22 and 23) has sustained heavy damage and is rated at 0 - 25% of its original cross-sectional area.

As shown in Table 4, the condition of the concrete piles is excellent. A total of 222 piles were included in the Level I inspection. No evidence of damage was found. Similarly, no evidence of damage was found on any of the 50 piles subjected to detailed Level II cleaning and inspection (see photographs 29 and 30).



PHOTOGRAPH No. 20

Bent 216 - Pile G. Note dense fouling and apparent good condition of pile.



PHOTOGRAPH No. 21

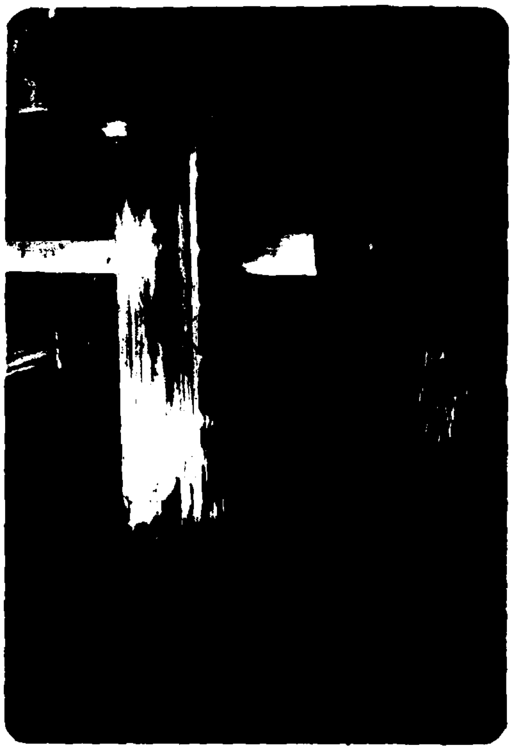
Bent 216 - Pile G. Note good condition of pile confirmed by removal of fouling.

PHOTOGRAPH No. 22

Bent 309.2 - Pile A1. 90% fungal and/or marine borer damage in splash and intertidal zones.

PHOTOGRAPH No. 23

Bent 309.2 - Pile A1. Approximately 90% section loss in intertidal zone.



PHOTOGRAPH No. 24

Bent 28 - Pile N. 75% mechanical and biological section loss from the cap to the intertidal zone.

PHOTOGRAPH No. 25

Bent 28 - Pile N. Approximately 50% marine borer and/or fungal section loss in intertidal zone.

PHOTOGRAPH No. 26

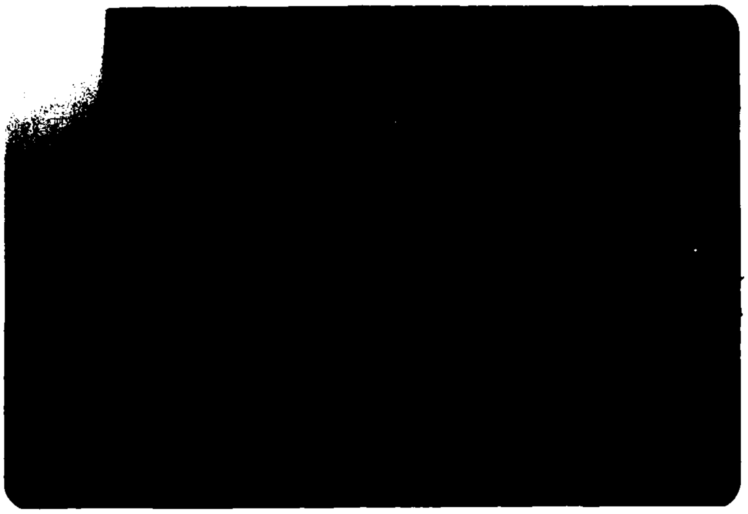
Bent 334 - Pile D. 90% cross section loss in splash zone due to fungal decay.

PHOTOGRAPH No. 27

Bent 352 - Pile A. Pile has been stubbed. The lower stub has sustained a loss of approximately 90% cross sectional area due to marine borer and/or fungal damage.

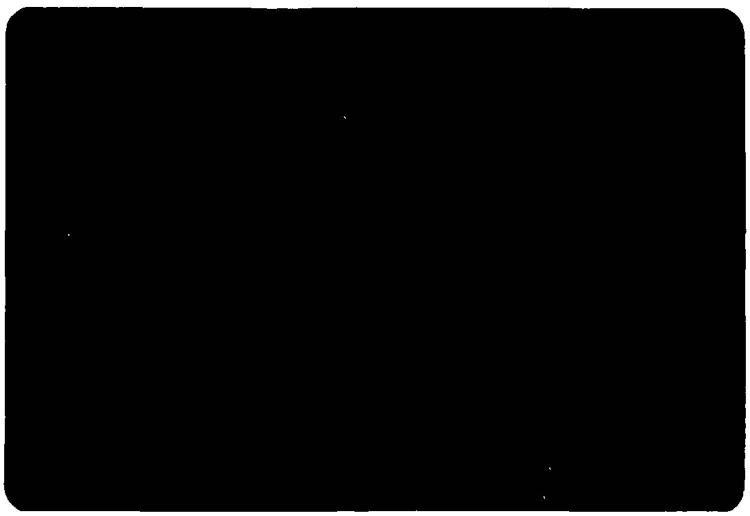
PHOTOGRAPH No. 28

Typical attack noted in intertidal zone of several piles. Decay extends in 1 - 2 inches and total section loss is generally less than 5%.



PHOTOGRAPH No. 29

Level II cleaned concrete pile. Note excellent condition of pile and density of fouling organisms.



PHOTOGRAPH No. 30

Level II cleaned pile. Note excellent condition of concrete at corner of pile. Also note turbidity of water.

4.2.3 Structural Condition Assessment

The majority of the inspected timber piles were found to be in excellent condition. The pile loading capacity for all Level III inspected piles is given in the computer print-out, Table 6. This Table gives the P-ULT, ultimate capacity of the pile column in pounds, based on the measured parameters of length, original diameter and remaining cross-sectional area. For details on the program, see the appendices.

Of the 393 piles inspected in the Level III inspection, only one pile will require maintenance at this time. A total of 12 piles from the Level I inspection were found to have sustained significant damage and will also require restorative maintenance or replacement. In addition to the above significantly damaged piles, 9 piles from the Level III inspection and 50 piles from the Level I inspection, were found to have sustained light attack or damage similar to that illustrated in photograph No. 28. As the damage to these piles is of a minor nature and does not significantly detract from the capacity of the piles, maintenance could be deferred at this time. Periodic inspections should, however, be carried out to monitor the condition of these piles.

The concrete piling in Pier 4 are in excellent condition. All 222 piles inspected in the Level I inspection as well as the 50 piles cleaned and inspected in the Level II inspection are undamaged and consequently, no maintenance of these members will be required.

4.2.4 Recommendations

It is recommended that the defective timber pile identified in the Level III inspection and detailed on Tables 5 and 6, be maintained. In addition, the 12 significantly damaged piles identified by the Level I inspection and listed below, should also be maintained. The defective piles are:

Bent	Row	Bent	Row
1	L	103	G
	R	309.2	A1
	S	317	A
28	W	331	D
40.8	Z	334	D
97	B	352	A

Effective maintenance of these piles could be achieved by the installation of a concrete jacket or alternately, by driving a new replacement pile adjacent to the defective pile. The estimated unit cost for either method is approximately $2,000.00, therefore the total estimated cost for repairing the defects identified by this inspection is approximately $26,000.00.

The total number of timber piles inspected in the Level I and Level III inspections is 1345. The total number of significantly damaged piles (13) represents only 1% of this total. When this level of damage is projected over the total 3783 timber piles in the structure, it is estimated that approximately 38 piles will require maintenance. The estimated cost of these repairs is approximately $75,000.00. See Table 7 for a summary of all maintenance required.

Given the excellent condition of the inspected concrete piles, no maintenance of these members will be required at this time.

Once the required maintenance to the timber piles has been carried out, the repairs should be re-inspected. This maintenance and re-inspection will serve to ensure the structural integrity of the facility.

In addition to the above re-inspection, it is also recommended that periodic inspections at three to five year intervals be carried out. These subsequent inspections will serve to identify any areas requiring maintenance and will thereby ensure the future structural integrity of the facility. All subsequent inspections should use this report as a datum or baseline.

LEGEND TO TABLES

B	=	*Bankia Setacea*
BR	=	Batter pile
Cap	=	"0" elevation
CR	=	Crack
D	=	Damaged
E	=	East
ITZ	=	Intertidal zone
L.	=	*Limnoria*
MBC	=	Marine borer cavity
MDL	=	Mudline
N	=	North
NB	=	Not bearing
S	=	South
SP	=	Spalling
UD	=	Undamaged
W	=	West

Example: Typical damage notation for concrete piles

37	-	A	SP	-10 to -15	12"	x	6"	RB	Exp.
Bent		Pile	Damage type	Elevation of damage with respect to the cap "0" point.	Width		Depth	Rebar	Exposed

TABLE 1

PIER 3 - LEVEL II
INSPECTION RESULTS OF CONCRETE PILES

PILE IDENTIFICATION Bent		Pile	DESCRIPTION OF DAMAGE
PIERHEAD			
6	-	N	UD
12	-	N	UD
18	-	N	UD
24	-	NE	UD
26	-	N	UD
32	-	N	UD
36	-	N	UD
42	-	N	UD
48	-	NW	UD
56	-	N	UD
62	-	N	UD
68	-	N	UD
72	-	NE	UD
74	-	N	UD
78	-	N	UD
84	-	N	UD
88	-	N	UD
91	-	N	UD
94	-	N	UD
laC	-	N	UD
3C	-	N	UD
		KSW	UD
		G	UD
		FSE	UD
		B	UD

Note: All piles were cleaned and inspected at the mid intertidal zone and the mudline.

TABLE 1

PIER 3 - LEVEL II
INSPECTION RESULTS OF CONCRETE PILES

PILE IDENTIFICATION Bent		Pile	DESCRIPTION OF DAMAGE
APPROACHWAY			
7C	-	E	UD
		C	UD
12C	-	B	UD
		C	UD
13C	-	B	UD
		C	UD
19C	-	B	UD
		C	UD
23C	-	B	UD
26C	-	CW-Br	UD
		BE-Br	UD
30C	-	B	UD
		C	UD
33C	-	B	UD
		C	UD
36C	-	C	UD
39C	-	B	UD
		C	UD
40C	-	B	UD
		C	UD
44C	-	B	UD
		C	UD
48C	-	C	UD
51C	-	B	UD
		C	UD

TABLE 2

PIER 3 - LEVEL III INSPECTION
IDENTIFICATION AND DETAILS OF DAMAGED PILES *

Pile ID Bent Pile	Area Rating	Remarks	Pile ID Bent Pile	Area Rating	Remarks
PIERHEAD					
13 - C	100	Trapped drift log.			
26 - L	100	2 open bolt holes in ITZ.			
38 - J	90	1% MBC in ITZ.			
R	90	1% MBC in ITZ.			
59 - J	100	Trapped drift log.			
APPROACH TRESTLE					
121 - G	75	Split at top down 3 ft., 25% mechanical section loss.			
141 - T	90	2% MBC in ITZ.			
142 - J	100	Open bolt hole in ITZ			
P	100	Open bolt hole in ITZ			
S	90	1% MBC and open bolt hole in ITZ.			
T	100	1% MBC in ITZ.			
161 - J	90	2% MBC in ITZ. Open bolt hole.			
201 - G	90	2% MBC in ITZ.			
ACCESS TRESTLE					
318 - A	75	Split at top down 4 ft., 25% mechanical section loss.			

* For undamaged piles, see Table 3.

TABLE 3

COLUMN LOAD CAPACITY CALCULATION

OF TIMBER PILING

Pile load capacities were calculated by an inhouse computer program using the Southern Pine Association modified Euler equation for long columns where,

$$P_{ult} = \frac{0.30\ E}{(L/d)^2} \times A$$

Pile lengths (L) were taken from mudline to cap. The unsupported length of pile (USL) was taken from below the bracing at the top and ten feet was added at the mudline to allow for the point of fixit,. Effective length factor (K) of 0.8 was used. Other program parameters used are described below:

Bent	-	bent identification
Pile	-	pile (row) identification
ITP	-	type of wood (1=fir)
Length	-	unsupported length - in this project, 5 feet was added onto the USL since the point of fixity at the bottom was considered to be 5 feet below the mudline.
EFF-L Factor	-	effective length factor, K. K=0.8 was used for these calculations
ORG-DIA	-	original pile diameter - taken at mudline
EFF-ARA	-	remaining cross-sectional area based on sonic testing, on the following basis:

Factor	Cross-Sectional area remaining
1.00	100%
0.90	90%-100%
0.75	75%-100%
0.50	50%- 75%
0.25	25%- 50%
0.005*	0%- 25%

(*the program cannot handle 0.000)

EFF-DIA	-	effective pile diameter
EFF-ARA	-	effective cross-sectional area of pile
C	-	compression parallel to grain, in psi, for fir
L/D	-	length over diameter ratio

P-ULT, LB - ultimate loading capacity of the pile column in pounds. This refers only to the column length as shown and does not take into account soil conditions (other than to establish the point of fixity), and what the pile was originally driven to in terms of design loads.

It is strongly emphasized that these calculations deal only with the ultimate capacity of the wood pile column within the fixity conditions and USL parameters as perceived. These load calculations are <u>not</u> design load calculations.

(Structural analysis in light of lateral loading was not included since this is considerably beyond the scope of this project. Such an analysis would require details on imposed lateral loading and structural analysis of the entire facility in terms of these loads and existing structural parameters.)

PIER 3
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
PIERHEAD											
1.8	H	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	K	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	N	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
2	A	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	B	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	C	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	D	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	E	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	F	1	31.00	0.800	1.080	1.000	1.080	131.92	825.	23	108831.
	G	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	J	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	L	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	P	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	R	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	S	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	T	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
2.2	H	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	K	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	N	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
12.8	H	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	K	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	N	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	ABR	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
13	A	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	B	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	C	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	D	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	E	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	F	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	G	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	J	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	L	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	P	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	R	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	T	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	ABR	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
13.2	H	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	K	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	N	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.

PIER 3
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
25.8	H	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	K	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	N	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
26	A	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	B	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	C	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	D	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	E	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	F	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	G	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	J	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	L	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	P	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	R	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	T	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	V	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	V.5	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	W	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
26.2	H	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	K	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	N	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
37.8	H	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	K	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	N	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
38	A	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	B	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	C	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	D	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	E	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	F	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	G	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	J	1	27.00	0.800	1.080	0.900	1.025	118.72	940.	21	111601.
	L	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	P	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	R	1	24.00	0.800	1.080	0.900	1.025	118.72	1025.	19	121693.
	S	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	T	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	V	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	W	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	ABR	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
38.2	H	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	K	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	N	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.

PIER 3
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
45.8	H	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	K	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	N	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
46	A	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	B	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	C	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	D	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	E	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	F	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	G	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	J	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	L	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	P	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	R	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	S	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	T	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	V	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	W	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	X	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	Y	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	Z	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	AA	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	AB	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
46.2	H	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	K	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	N	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
48.8	H	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	K	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	N	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
49	A	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	B	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	C	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	D	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	E	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	F	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	G	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	J	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	L	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	P	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	R	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	S	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	T	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	V	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	W	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	X	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	Y	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.

PIER 3
PILE LOADING CAPACITIES
NWS CONCOPD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	Z	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	AA	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	AB	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
49.2	G	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	H	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	K	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	N	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
55.8	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	K	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	N	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	NW	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
56	A	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	A.5	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	B	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	B.5	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	C	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	D	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	E	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	F	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	G	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	J	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	L	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	P	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	R	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	S	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	T	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	V	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	W	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
56.2	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	K	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	N	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
58.8	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	K	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	N	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
59	A	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	B	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	C	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	D	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	E	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	F	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	G	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	J	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	L	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	P	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	R	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.

PIER 3
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	S	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	T	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
59.2	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	K	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	N	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
65.8	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	K	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	N	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
66	A	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	B	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	C	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	D	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	E	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	F	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	G	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	H1.2	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	J	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	K	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	L	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	P	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	R	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	S	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	T	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
66.2	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	K	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	N	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
70.8	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	K	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	N	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	S	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
71	A	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	B	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	C	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	D	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	E	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	F	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	G	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	J	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	L	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	P	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	T	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
70.2	H	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.

PIER 3
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	K	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	N	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	S	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
81.8	H	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	K	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	N	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	S	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
82	A	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	B	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	C	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	D	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	E	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	F	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	G	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	J	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	L	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	P	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	T	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	AWB	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	ASB	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
82.2	H	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	K	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	N	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	S	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
93.8	H	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	K	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	N	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
94	A	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	B	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	C	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	D	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	E	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	F	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	G	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	J	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	L	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	P	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	T	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
94.2	H	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	K	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	N	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.

PIER 3
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
APPROACH TRESTLE											
106	F	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	G	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	H	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	J	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	J2	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	K	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	L	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	L2	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	N	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N2	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	P	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	S	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	T	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	FBR	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	TBR	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
121	F.5	1	48.00	0.800	1.080	1.000	1.080	131.92	380.	36	50087.
	G	1	46.00	0.800	1.080	0.750	0.935	98.94	310.	39	30677.
	H	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	J	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	K	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	L	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	N2	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	P	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	T	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
122	G	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	H	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	J	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	K	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	L	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	L2	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	N2	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	P	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	T	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	GBR	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	TBR	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
141	G	1	52.00	0.800	1.080	1.000	1.080	131.92	324.	39	42678.
	H	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
	J	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	P	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	S	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.

PIER 3
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	T	1	33.00	0.800	1.080	0.900	1.025	118.72	650.	26	77171.
	GBR	1	52.00	0.800	1.080	1.000	1.080	131.92	324.	39	42678.
142	G	1	52.00	0.800	1.080	1.000	1.080	131.92	324.	39	42678.
	H	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
	J	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	P	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	S	1	36.00	0.800	1.080	0.900	1.025	118.72	608.	28	72125.
	T	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
161	G	1	48.00	0.800	1.080	1.000	1.080	131.92	380.	36	50087.
	H	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	J	1	40.00	0.800	1.080	0.900	1.025	118.72	492.	31	58421.
	P	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	S	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	T	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	TBR	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
162	G	1	48.00	0.800	1.080	1.000	1.080	131.92	380.	36	50087.
	H	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	J	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	P	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	S	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	T	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	TBR	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
181	G	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	J	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	P	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	S	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	T	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	TBR	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
182	G	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	H	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	J	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	P	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	S	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	T	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	TBR	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
201	G	1	22.00	0.800	1.080	0.900	1.025	118.72	1085.	17	128817.
	H	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	J	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	P	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	S	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	T	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	TBR	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.

PIER 3
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
202	F 5	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	G	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	H	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	J	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	P	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	S	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	T	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	TBR	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
221	G	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	H	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	J	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	P	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	S	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	T	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	GBR	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
222	G	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	H	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	J	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	P	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	S	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	T	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	TBR	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
241	G	1	16.00	0.800	1.080	1.000	1.080	131.92	1170.	12	154342.
	H	1	16.00	0.800	1.080	1.000	1.080	131.92	1170.	12	154342.
	AC	1	16.00	0.800	1.080	1.000	1.080	131.92	1170.	12	154342.
	AH	1	16.00	0.800	1.080	1.000	1.080	131.92	1170.	12	154342.
	J	1	15.00	0.800	1.080	1.000	1.080	131.92	1185.	11	156321.
	J2	1	15.00	0.800	1.080	1.000	1.080	131.92	1185.	11	156321.
	P	1	14.00	0.800	1.080	1.000	1.080	131.92	1200.	10	158300.
	S	1	13.00	0.800	1.080	1.000	1.080	131.92	1200.	10	158300.
	T	1	12.00	0.800	1.080	1.000	1.080	131.92	1200.	9	158300.
	GBR	1	16.00	0.800	1.080	1.000	1.080	131.92	1170.	12	154342.
		1	0.0	0.800	1.080	1.000	1.080	131.92	1200.	0	158300.
ACCESS TRESTLE											
308	A1	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	A2	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	A3	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	A	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	B	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	C	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	D	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
318	A	1	22.00	0.800	1.080	0.750	0.935	98.94	1025.	19	101411.

PIER 3
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	B	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	C	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	D	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
331	A	1	19.00	0.800	1.080	1.000	1.080	131.92	1150.	14	151704.
	B	1	19.00	0.800	1.080	1.000	1.080	131.92	1150.	14	151704.
	C	1	19.00	0.800	1.080	1.000	1.080	131.92	1150.	14	151704.
	D	1	19.00	0.800	1.080	1.000	1.080	131.92	1150.	14	151704.
	E	1	19.00	0.800	1.080	1.000	1.080	131.92	1150.	14	151704.

TABLE 4

PIER 4 - LEVEL II
INSPECTION RESULTS OF CONCRETE PILES

	PILE IDENTIFICATION Bent		Pile	DESCRIPTION OF DAMAGE
PIERHEAD	6	-	N	UD
	12	-	N	UD
	18	-	N	UD
	24	-	NW	UD
	26	-	N	UD
	32	-	N	UD
	36	-	N	UD
	42	-	N	UD
	48	-	NE	UD
	56	-	N	UD
	62	-	N	UD
	68	-	N	UD
	72	-	NE	UD
	74	-	N	UD
	78	-	N	UD
	84	-	N	UD
	88	-	N	UD
	91	-	N	UD
	94	-	N	UD
	1aC	-	N	UD
	3C	-	N	UD
			KSW	UD
			KNW	UD
			G	UD
			ENE	UD
			ESE	UD

Note: All piles were cleaned and inspected at the mid intertidal zone and the mudline.

TABLE 4

PIER 4 - LEVEL II
INSPECTION RESULTS OF CONCRETE PILES

PILE IDENTIFICATION Bent		Pile	DESCRIPTION OF DAMAGE
APPROACHWAY			
7C	-	B	UD
		E	UD
12C	-	C	UD
13C	-	B	UD
16C	-	B	UD
21C	-	B	UD
		C	UD
25C	-	CW-Br	UD
		BE-Br	UD
28C	-	B	UD
32C	-	B	UD
		C	UD
37C	-	B	UD
		C	UD
38C	-	B	UD
		C	UD
42C	-	B	UD
		C	UD
46C	-	B	UD
		C	UD
50C	-	CW-Br	UD
		BE-Br	UD
54C	-	B	UD
57C	-	B	UD

TABLE 5

PIER 4 - LEVEL III INSPECTION
IDENTIFICATION AND DETAILS OF DAMAGED PILES *

Pile ID Bent Pile	Area Rating	Remarks	Pile ID Bent Pile	Area Rating	Remarks
PIERHEAD			122 - H.5	100	New pile.
2 - C	90	1% MBC in ITZ.	T	100	1% MBC in ITZ.
F	90	1% MBC in ITZ.	141 - G	100	1% MBC in ITZ.
13.2 - H	90	1% MBC in ITZ.	T	100	1% MBC in ITZ.
26 - L	100	Open bolt hole in ITZ	142 - G	100	1% MBC in ITZ.
46 - V	90	2% MBC in ITZ.	201 - G	100	1% MBC in ITZ.
X	90	1% MBC in ITZ.	P	100	1% MBC in ITZ.
49 - Y	90	1% MBC in ITZ.			
56 - A	90	1% MBC in ITZ.	ACCESS TRESTLE		
B	90	1% MBC in ITZ.	303 - A	90	1% mech. and fungal sec. loss in ITZ.
65.8 - K	100	Less than 1% mech. sec. loss in ITZ.	309.2 - A	0	90% MB/fungal section loss in ITZ.
66 - B	100	Light L. attack.			
71 - F	100	Small mech. ring-shake off at MDL.			
82 -		Trapped drift log between Bents 82-83.			
APPROACH TRESTLE					
106 - L-Br	100	1% MBC in ITZ.			
121 - G.5	100	New pile. **			
H.5	100	New pile.			
J.5	100	New pile.			
K.5	100	New pile.			
L.5	100	New pile.			
N.5	100	New pile.			
N2.5	100	New Pile.			
P.5	100	New pile.			

* For undamaged piles, see Table 6.
** New pile installed Fall '82 to repair ship impact damage.

TABLE 6

COLUMN LOAD CAPACITY CALCULATION

OF TIMBER PILING

Pile load capacities were calculated by an inhouse computer program using the Southern Pine Association modified Euler equation for long columns where,

$$P_{ult} = \frac{0.30\ E}{(L/d)^2} \times A$$

Pile lengths (L) were taken from mudline to cap. The unsupported length of pile (USL) was taken from below the bracing at the top and ten feet was added at the mudline to allow for the point of fixity. Effective length factor (K) of 0.8 was used. Other program parameters used are described below:

Bent	-	bent identification
Pile	-	pile (row) identification
ITP	-	type of wood (1=fir)
Length	-	unsupported length - in this project, 5 feet was added onto the USL since the point of fixity at the bottom was considered to be 5 feet below the mudline.
EFF-L Factor	-	effective length factor, K. K=0.8 was used for these calculations
ORG-DIA	-	original pile diameter - taken at mudline
EFF-ARA	-	remaining cross-sectional area based on sonic testing, on the following basis:

Factor	Cross-Sectional area remaining
1.00	100%
0.90	90%-100%
0.75	75%-100%
0.50	50%- 75%
0.25	25%- 50%
0.005*	0%- 25%

(*the program cannot handle 0.000)

EFF-DIA	-	effective pile diameter
EFF-ARA	-	effective cross-sectional area of pile
C	-	compression parallel to grain, in psi, for fir
L/D	-	length over diameter ratio

P-ULT, LB - ultimate loading capacity of the pile column in pounds. This refers only to the column length as shown and does not take into account soil conditions (other than to establish the point of fixity), and what the pile was originally driven to in terms of design loads.

It is strongly emphasized that these calculations deal only with the ultimate capacity of the wood pile column within the fixity conditions and USL parameters as perceived. These load calculations are not design load calculations.

(Structural analysis in light of lateral loading was not included since this is considerably beyond the scope of this project. Such an analysis would require details on imposed lateral loading and structural analysis of the entire facility in terms of these loads and existing structural parameters.)

PIER 4
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
PIERHEAD											
1.8	H	1	50.00	0.800	1.080	1.000	1.080	131.92	350.	37	46160.
	K	1	49.00	0.800	1.080	1.000	1.080	131.92	364.	36	48064.
	N	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
2	A	1	54.00	0.800	1.080	1.000	1.080	131.92	300.	40	39575.
	B	1	53.00	0.800	1.080	1.000	1.080	131.92	311.	39	41082.
	C	1	52.00	0.800	1.080	0.900	1.025	118.72	291.	41	34569.
	D	1	52.00	0.800	1.080	1.000	1.080	131.92	324.	39	42678.
	E	1	52.00	0.800	1.080	0.900	1.025	118.72	291.	41	34569.
	F	1	51.00	0.800	1.080	1.000	1.080	131.92	336.	38	44368.
	G	1	50.00	0.800	1.080	1.000	1.080	131.92	350.	37	46160.
	J	1	49.00	0.800	1.080	1.000	1.080	131.92	364.	36	48064.
	L	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
	P	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	R	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	S	1	45.00	0.800	1.080	1.000	1.080	131.92	432.	33	56988.
	T	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
2.2	H	1	50.00	0.800	1.080	1.000	1.080	131.92	350.	37	46160.
	K	1	49.00	0.800	1.080	1.000	1.080	131.92	364.	36	48064.
	N	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
12.8	H	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	K	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	N	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	ABR	1	51.00	0.800	1.080	1.000	1.080	131.92	336.	38	44368.
13	A	1	51.00	0.800	1.080	1.000	1.080	131.92	336.	38	44368.
	B	1	50.00	0.800	1.080	1.000	1.080	131.92	350.	37	46160.
	C	1	49.00	0.800	1.080	1.000	1.080	131.92	364.	36	48064.
	D	1	48.00	0.800	1.080	1.000	1.080	131.92	380.	36	50087.
	E	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
	F	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	G	1	45.00	0.800	1.080	1.000	1.080	131.92	432.	33	56988.
	J	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	L	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	P	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	R	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	S	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	T	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	ABR	1	51.00	0.800	1.080	1.000	1.080	131.92	336.	38	44368.
13.2	H	1	44.00	0.800	1.080	0.900	1.025	118.72	407.	34	48282.
	K	1	49.00	0.800	1.080	1.000	1.080	131.92	364.	36	48064.
	N	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
25.8	H	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.

PIER 4
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	K	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
26	A	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	B	1	45.00	0.800	1.080	1.000	1.080	131.92	432.	33	56988.
	C	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	D	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	E	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	F	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	G	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	J	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	L	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	P	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	R	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	T	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	V	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	V.5	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	W	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
26.2	H	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	K	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
37.8	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	K	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	N	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
38	A	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	B	1	45.00	0.800	1.080	1.000	1.080	131.92	432.	33	56988.
	C	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	D	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	E	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	F	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	G	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	J	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	L	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	P	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	R	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	S	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	T	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	V	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	W	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	ABR	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
38.2	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	K	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	N	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
45.8	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.

PIER 4
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	K	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	N	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
46	A	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	B	1	45.00	0.800	1.080	1.000	1.080	131.92	432.	33	56988.
	C	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	D	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	E	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	F	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	G	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	J	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	L	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	P	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	R	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	S	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	T	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	V	1	25.00	0.800	1.080	0.900	1.025	118.72	990.	20	117538.
	W	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	X	1	24.00	0.800	1.080	0.900	1.025	118.72	1025.	19	121693.
	Y	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	Z	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	AA	1	46.00	0.800	1.080	1.000	1.030	131.92	413.	34	54537.
	AB	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
46.2	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	K	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	N	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
48.8	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	K	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
49	A	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	B	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	C	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	D	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	E	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	F	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	G	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	J	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	L	1	31.00	0.800	1.080	1.000	1.080	131.92	825.	23	108831.
	P	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	R	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	T	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	V	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	W	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	X	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	Y	1	23.00	0.800	1.080	0.900	1.025	118.72	1060.	18	125848.
	Z	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.

PIER 4
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	AA	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	AB	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
49.2	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	K	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
55.8	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	K	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
56	A	1	46.00	0.800	1.080	0.900	1.025	118.72	372.	36	44175.
	B	1	45.00	0.800	1.080	0.900	1.025	118.72	389.	35	46160.
	C	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	D	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	E	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	F	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	G	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	J	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	L	1	31.00	0.800	1.080	1.000	1.080	131.92	825.	23	108831.
	P	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	R	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	T	1	24.00	0.600	1.080	1.000	1.080	131.92	1060.	18	139832.
	V	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	W	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
56.2	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	K	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	29.00	0 800	1.080	1.000	1.080	131.92	940.	21	124002.
58.8	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	K	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
59	A	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
	B	1	45.00	0.800	1.080	1.000	1.080	131.92	432.	33	56988.
	C	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	D	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	E	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	F	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	G	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	J	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	L	1	31.00	0.800	1.080	1.000	1.080	131.92	825.	23	108831.
	P	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	R	1	26.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	S	1	25.00	0.800	1.080	1.000	1.080	131.92	1025.	19	135215.
	T	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
59.2	H	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.

PIER 4
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	K	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	N	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
65.8	H	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	K	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	N	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
66	A	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
	B	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	C	1	45.00	0.800	1.080	1.000	1.080	131.92	432.	33	56988.
	D	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	E	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	F	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	G	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	J	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	L	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	P	1	31.00	0.800	1.080	1.000	1.080	131.92	825.	23	108831.
	R	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	S	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	T	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
66.2	H	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	K	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	N	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
70.8	H	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	K	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	N	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	S	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
71	A	1	48.00	0.800	1.080	1.000	1.080	131.92	380.	36	50087.
	B	1	47.00	0.800	1.080	1.000	1.080	131.92	396.	35	52241.
	C	1	46.00	0.800	1.080	1.000	1.080	131.92	413.	34	54537.
	D	1	45.00	0.800	1.080	1.000	1.080	131.92	432.	33	56988.
	E	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	F	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	G	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	J	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	L	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	P	1	33.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	T	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
71.2	H	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	K	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	N	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	S	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
81.8	H	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	K	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	N	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.

PIER 4
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	K	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	L	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	L2	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
	N	1	38.00	0.800	1.080	1.000	1.080	131.92	606.	28	79917.
	N2	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	P	1	37.00	0.800	1.080	1.000	1.080	131.92	639.	27	84296.
	S	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	T	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	JZBR	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	LBR	1	39.00	0.800	1.080	1.000	1.080	131.92	575.	29	75872.
121	G	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	G.5	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	H	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	H.5	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	J	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	J.5	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	K	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	K.5	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	L	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	L.5	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	L2	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	N	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	N.5	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	N2	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	N2.5	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	P	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	P.5	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	S	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	T	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
122	G	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	H	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	H.5	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	J	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	K	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	L	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	L2	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	N	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	N2	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	P	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	S	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	T	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
	LZBR	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	NZBR	1	40.00	0.800	1.080	1.000	1.080	131.92	547.	30	72125.
141	G	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	H	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	J	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	P	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.

PIER 4
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
	S	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	T	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	GBR	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
142	G	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	H	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	J	1	42.00	0.800	1.080	1.000	1.080	131.92	496.	31	65420.
	P	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	S	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	T	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	TBR	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
161	G	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	H	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	J	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	P	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	S	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	T	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	TBR	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
162	G	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	H	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	J	1	41.00	0.800	1.080	1.000	1.080	131.92	520.	30	68650.
	P	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	S	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	T	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
	TBR	1	44.00	0.800	1.080	1.000	1.080	131.92	452.	33	59608.
181	G	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	H	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	J	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	P	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	S	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	T	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	TBR	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
182	G	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	H	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	J	1	36.00	0.800	1.080	1.000	1.080	131.92	675.	27	89044.
	P	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	S	1	35.00	0.800	1.080	1.000	1.080	131.92	650.	26	85746.
	T	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
	TBR	1	34.00	0.800	1.080	1.000	1.080	131.92	705.	25	93001.
201	G	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	H	1	31.00	0.800	1.080	1.000	1.080	131.92	825.	23	108831.
	J	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	S	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	T	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	TBR	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.

PIER 4
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
202	G	1	32.00	0.800	1.080	1.000	1.080	131.92	760.	24	100257.
	H	1	31.00	0.800	1.080	1.000	1.080	131.92	825.	23	108831.
	J	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	P	1	30.00	0.800	1.080	1.000	1.080	131.92	890.	22	117406.
	S	1	29.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	T	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	TBR	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
221	G	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	H	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	J	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	P	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	S	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	T	1	20.00	0.800	1.080	1.000	1.080	131.92	1130.	15	149066.
	GBR	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
222	G	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
	H	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	J	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	P	1	22.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	S	1	21.00	0.800	1.080	1.000	1.080	131.92	1110.	16	146427.
	T	1	20.00	0.800	1.080	1.000	1.080	131.92	1130.	15	149066.
	GBR	1	24.00	0.800	1.080	1.000	1.080	131.92	1060.	18	139832.
ACCESS TRESTLE											
303	A	1	27.00	0.800	1.080	0.900	1.025	118.72	940.	21	111601.
	B	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	C	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	D	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
303.	2A1	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	A2	1	27.00	0.800	1.080	1.000	1.080	131.92	990.	20	130597.
	A3	1	0.0	0.800	1.080	1.000	1.080	131.92	1200.	0	158300.
309	A	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	B	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	C	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	D	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
309.	2A1	1	43.00	0.800	1.080	0.005	0.076	0.66	2.	450	2.
	A2	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
	A3	1	43.00	0.800	1.080	1.000	1.080	131.92	473.	32	62413.
332	A	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	B	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	C	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.
	D	1	28.00	0.800	1.080	1.000	1.080	131.92	940.	21	124002.

PIER 4
PILE LOADING CAPACITIES
NWS CONCORD CA.

BENT	PILE	ITP	LENGTH FT	EFF-L FACTOR	ORG-DIA FT	EFF-ARA FACTOR	EFF-DIA FT	EFF-ARA IN2	C PSI	L/D	P-ULT LB
356	A	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	B	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	C	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.
	D	1	23.00	0.800	1.080	1.000	1.080	131.92	1085.	17	143130.

TABLE 7

COST ESTIMATE FOR REQUIRED MAINTENANCE

STRUCTURE	DAMAGE/DEFECTS FOUND	RECOMMENDED REPAIRS	UNIT COST OF REPAIR	TOTAL COST OF REPAIRS FOR CURRENT INSPECTION (SAMPLING)	TOTAL ESTIMATED NUMBER OF DAMAGED MEMBERS *	ESTIMATED TOTAL COST OF REPAIRS FOR PROJECTED DAMAGE
PIER 3	10 Timber piles (.7%)	Replace with new creosoted pile or install concrete jacket to restore bearing capacity.	$2,000	$20,000	.7% 26 piles	$50,000
PIER 4	13 timber piles (1%)	Replace with new creosoted pile or install concrete jacket to restore bearing capacity.	$2,000	$26,000	1% 38 piles	$75,000

*Based on projecting the percentage of damage found over the total number of piles in the structure

END

DATE

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